Editorial

IN last month's issue, I expressed the opinion that we would be wise to re-examine the whole television position in Australia in the light of recent important developments, with particular reference to color. I stressed the importance of the step we were about to take, and the fact that it is impracticable to change a television system once adopted, without great difficulty and expense, not only to the trade, but to the general public.

The issue had scarcely hit the bookstalls before the new Post Master General announced he intended to adopt just this procedure, and that at the appropriate time he would call for new tenders for a television service.

It was inevitable that this announcement should have been received with mixed feelings. As far as I can judge, these feelings reflected pretty clearly the interest which those expressing them have in television.

There are many people whose interest would be served if television were pushed ahead with at once, irrespective of standards or the possibility of radical changes taking place before the equipment is ready for use. The obvious viewpoint for them to take is that we are lagging behind in television, and should therefore plunge into this ticklish and unstable business for the joy of having something new.

Now the principle of television at any price isn't realistic, economic, or practicable. The price is going to be high, the returns, if overseas experience is worth anything, are at present dubious, and we just cannot afford to chop and change about once our feet have been placed on the television road.

At the moment, there is no country in the world which shows any sign of stability in its television industry. The quickest and surest way to ensure that we will lag behind would be to go ahead with one or other of the present black and white standards, only to see some better system outdate it very smartly, and leave us looking very foolish indeed.

I cannot see any evidence at the moment that Australians are waiting on television with bated breath, suffering a keen sense of deprivation without it. I can see, however, plenty of evidence that television is in danger of being badly oversold.

Mr. Anthony therefore is well advised to satisfy his own mind about the whole subject before making any decisions at this stage. He has every reason to do so, and we have everything to gain by marking time until there is some semblance of finality in sight.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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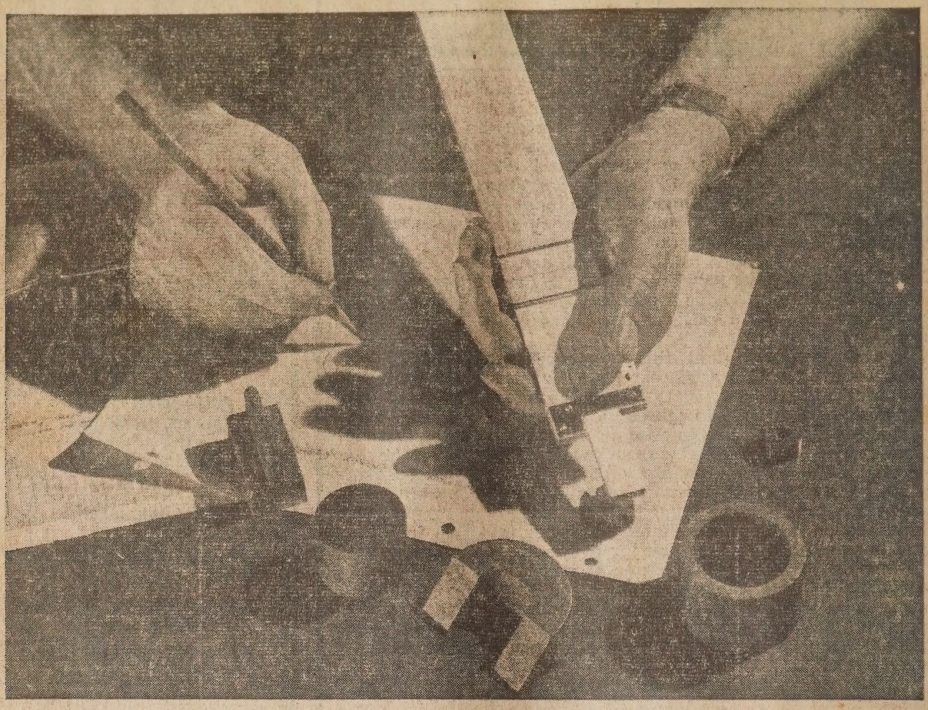

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Chief credit for this improvement must go to the physicists who evolved the Alnico magnet alloys and brought them to their present pitch of efficiency. Among the world organisations engaged in magnet manufacture, Rola Company (Aust.) Pty. Ltd. has been in the forefront of this research and developed the famous Anisotropic Alnico used in its loudspeakers during the past four years.

Now Rola Company (Aust.) Pty. Ltd. researchers have evolved an even better magnet alloy, one which permits a further 25% reduction in loudspeaker magnet weight without impairing the high efficiency of its famous loudspeakers.

You'll be seeing some of these new loudspeakers soon. Though you won't be able to detect any difference in their performance compared with that of earlier models you'll know them by their shorter magnets, a visual example of the progressive thinking and engineering skill which has made Rola "The World's Finest Loudspeaker."

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GIANT BRITISH TELEVISION MAST

The transmitter building and 750 ft mast of England's big television station. The mast carries a wide band aerial of two tiers of four vertical folded dipoles arranged in cruciform to radiate both sound and vision. The slot radiator below will be used for future VHF broadcasting.

PROPOSED AUTOMATIC AIR CONTROL

Automatically exchanged signals between the ground control station and airborne planes instantly record any deviations from a pre-arranged course, thus guarding safety at all times with an electric eye.

The problem of air accident is always with us. No matter how carefully organisation is prepared, there seems to be always the unforseen case which "gets by" the most elaborate control systems. And yet absolute safety in the air is quite essential to the full development of aviation. Crashes not only mean the loss of valuable lives, but through material damage, and damage to prestige, pile up heavy losses. This article gives the broad outline of a new control system which, it is claimed, will make flying just about as safe as walking across a street, if not safer.

THERE are a number of essential requirements which must be met by any aircraft control system which is to be universal and effective. It must be capable of fitment to any aircraft, large or small, at least to a degree sufficient to allow that aircraft to tie in with the essentials of landing and flying safety, remembering that for a light sporting plane these may not be so elaborate as for a large airliner.

REQUIREMENTS

It must be capable of universal application and be universally accepted. It would be little use if every country adopted a different and complex system. In these days of global travel this is a most important point, as no aircraft can be expected to carry a number of systems.

It must be foolproof in its operation and employ a type of display which can be read easily and quickly. A pilot in an emergency is today loaded up with just about as many things to think about as can be handled by a single brain; and the simplification of his task, even though the saving can be measured in fractions of a second, means much when lives are at stake.

There are various types of navigational aids now in use, including long-distance beams for course flying, approach systems, and landing systems. From time to time many attempts have been made to combine as many of these as possible into a single system which, being automatic in operation, requires no action on the part of the pilot.

Some of these systems, in the past, have been most effective, but the method of display used to convey the information to the pilot have been far from simple. Special training courses have been required in some cases before the display could be interpreted, particularly with equipments designed during the war.

The United States Government, it is reported, has adopted a new Air Traffic Control Plan, which, when in force, will do much to render American flying crash-proof. The plan was successful in winning the Collier Trophy, established in 1911 by Collier's Magazine, which describes the device in these terms:—

FLIGHT PLAN

Before any plane can leave the ground, the pilot must file a flight plan with Operations at the airfield, listing his destination and route. The flight plan is rushed to the nearest Air Traffic Control Centre (usually 20 miles or so outside major cities), where the plane is assigned an altitude, a lane, an arrival time, and so on.

All the information is punched out on a card. The card then is inserted in the giant electronic computer mechanism. If the punched holes indicate to the machine that the flight will conflict with any other flight in the vicinity, the computer automatically rejects the card and indicates the point of conflict. If the flight plan is okay, the card remains in the computer, and the pilot is given permission to take off.

From the moment the pilot steps into his cockpit, another miraculous machine begins operating. This is a tiny radio transmitter called a "transponder," which sends its radio signals directly from the plane to the computer on the ground. While the aircraft is in flight, these signals go out constantly to the nearest computer.

IDENTIFICATION

One series of distinctive signals keeps identifying the plane (in the same way that a vocalist has a particular singing style). The transponder's automatic signal tells the computer how far the plane is from the computer at that moment, and it gives the direction of the plane.

Another ingenious device in the transponder automatically shifts

TO OUTLAW AIRCRAFT ACCIDENTS

the tone of the signals as the plane goes up or down, so the computer receives a constant record of the altitude of the plane as well as its position and bearing. The machine thus knows exactly where the plane is at all times.

Each computer receives dozens of such signals every second from each plane in its area of responsibility (a radius of from 100 to 500 miles). In the computer, each plane's signal is checked electronically against the punch-holes in the flight-plan card, which indicates to the machine where every plane is *supposed* to be.

The moment a plane strays off this course, or falls behind because of head winds, or loses altitude, its signals no longer match the punch-hole cards in the computer, and the alarm bells and lights go into action. The moment *this* happens, a traffic-control expert presses buttons like mad. The buttons light up instructions on the plane's instrument-panel, telling the pilot what to do to get back on course.

AVOIDNG CONGESTION

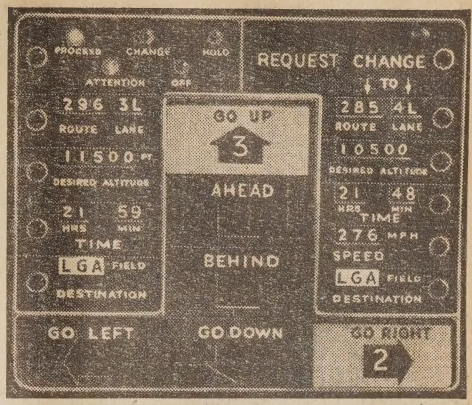
If other planes are endangered by the deviation of Plane Number One the traffic-control man presses buttons which light up the panel boards in the other planes, telling *them* what to do. In other words, the traffic-control centre is like a puppet-master manipulating many puppets in the air at once—except that the puppets are attached by radio beams instead of strings. There are no voice signals to become garbled by imperfect pronunciation or static, no hysterical thinking in airport control towers—just nerveless, errorless electronic fingers that guide each plane through all kinds of weather directly onto the runway at its destination.

At first, the system will include equipment already in use, like ground-controlled radar landings, but later will accomplish things never dreamed of before. For instance, if a plane is instructed to change its course while in flight, the computer on the ground automatically adopts the new course and trips the alarms if the plane strays from it.

ALTITUDE

If a pilot runs into icing conditions at his assigned altitude of, say 11,000 feet, the pilot changes the lighted-up number "11,000" on his air-to-ground side of the instrument panel to "9000" and he presses a button marked "Request change." If there is another plane at 9000 feet, the electronic computer on the ground rejects the request, and the traffic man flashes a "Hold!" sign on the instrument panel of the plane. He then calls on the computer to find an *un*occupied lower altitude. The computer turns up 7000 feet. The traffic man presses a button, and in a flash, the lighted-up "11,000" altitude marker in the plane spins around like any automobile speedometer to become "7000." The plane goes down to 7000ft.

Similarly, if a plane encounters head winds and is running six minutes behind its assigned landing time at La Guardia Field, the computer flashes the warning, and the traffic man tries to hasten the plane along. If the aircraft can't respond with any more speed, the traffic man consults the computer to see if the plane will now conflict with another plane's landing at La Guardia. If this seems likely, he slows down the problem-child aircraft, to bring it in at a *later* landing time, reserved exclusively for itself. This will end disconcerting "stacking" of planes over airports.



A typical control panel fitted to an aircraft on which is displayed any flying directions required to keep it on its course.

HOW IT WORKS

And so go the details of the plan, which sound like Buck Rogers fantasies now, but which will be no more startling a few years hence than automatic safety signals on railroads. Some 300 very-high-frequency omni-directional ranges already are in use in the United States; and New York, Washington and Chicago have installed new surveillance radar which will help locate errant planes until the computers and transponders begin to operate in 1960. Contracts already have been let for some of the elements that will go into the transponders, and engineers are beginning to move the giant computers into the blueprint stage.

Last November 1, a Bolivian P-38 fighter plane and a DC-4 airliner tried to land simultaneously at Washington's National Airport, with the result that 55 people perished in the nation's worst air disaster. Not long before that, a US Navy fighter plane dissected a DC-3 airliner in mid-air, precipitating further carnage; and in another crash, Marcel Cerdan and all his fellow passengers were killed when their transatlantic Constellation cracked up against a mountain-top in the Azores.

Had the new system been in effect, this is what would have happened: The moment the Bolivian P-38 deviated from its course and began its fatal dive onto the unsuspecting DC-4, an automatic radio impulse would have been transmitted to a giant electronic computer miles away on the ground. This would have set off an alarm bell located in the ground station, and the computer would have flashed warning lights, much in the manner of a tilted pinball machine.

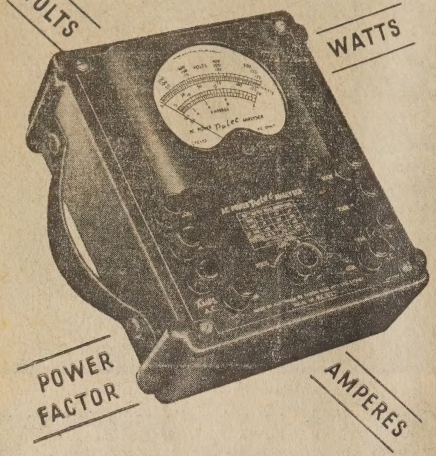
Almost immediately thereafter, similar alarm bells and lights would have given warning in the cockpits of both planes. One light in the DC-4 cockpit would have flashed, "Attention!" and another would have lighted up brilliantly with the words, "Go left 22 degrees!" An "Attention!" light would have blazed on the instrument panel of the P-38, too, with another panel light, lighted up by radio from the ground, saying, "Go up 2000 feet!" and "Go right 10 degrees!" The planes would have missed each other by at least a mile, and 55 victims would be alive today.

RISK OF COLLISION

The same thing would have happened in the case of the Navy fighter and the DC-3; and, also, the Constellation in which Cerdan was flying never could have drifted 90 miles off its course. The moment it deviated even a single degree, the alarms would have gone off in a ground computer station, and the "Attention!" signal would have commenced its pyrotechnic commotion in the Constellation's cockpit. Furthermore, a light on the plane's instrument board would have flashed the words, "Go left one degree!" and instead of flying full speed into the mountain on Sao Miguel Island, the Constellation would have let down safely through the clouds to the airfield on Santa Maria.

As all this indicates, the newly adopted Air Traffic Control Plan will make the pilot mostly an agent for carrying out the orders of the electronic brain on the ground; and, accordingly, the possibility of human error and frailty will be eliminated almost completely from flying.

2 NEW PALEC STARS



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1

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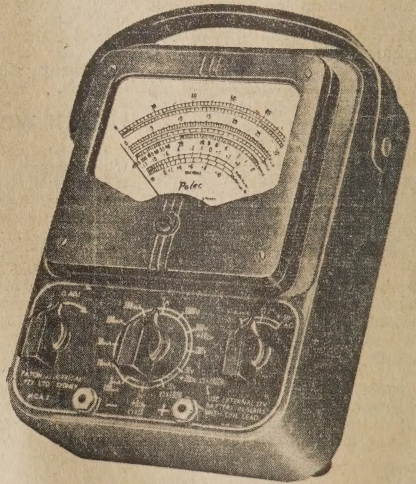

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NEW BBC LONG RANGE TELEVISION

The opening of the new Television Transmitting Station at Sutton Coldfield on December 17, 1949, marks the first step in the extension of television to the whole of Great Britain. It is estimated that with the opening of this new station another 6 million potential viewers will be added to the television audience. Planned by the British Broadcastcasting Corporation's engineers, and equipped with apparatus of British design and manufacture, the station is the most powerful of its kind in the world.

The transmitter hall. In the foreground is the vision transmitter capable of 40KW peak output. Beyond is the sound transmitter with an average carrier power of 12 KW. On the left, through the curve window is the control room from which both transmitters are operated.

An engineer measures the frequency response of the vision modulator.

THE station is on a 24-acre site, ten miles north of Birmingham and 550 feet above sea level. A 750-feet mast supports the combined television and sound aerial, the mast being the tallest ever erected for the British Broadcasting Corporation.

There are no studios at Sutton Coldfield, the station taking its programmes from the London Television Station at Alexandra Palace and retransmitting them. The vision-programme signals are sent from London to Birmingham over the ultra-high-frequency radio link, provided specially by the General Post Office for the purpose, and over a special coaxial cable for the first stage of the journey from Alexandra Palace to Museum Telephone Exchange and the last stage from Birmingham to Sutton Coldfield.

The 750-foot high mast has an all-up weight of 140 tons and is supported by four sets of stays. With the station altitude of 550 feet the mast brings the transmitting aerial to a height of 1300 feet above sea level. The base of the mast is located by a steel ball in a socket, which forms a pivot to allow angular movement in high winds. From the base to the 610 feet level the mast is triangular, and from 610 to 710 feet is cylindrical. A lift for engineers is installed up to the 610-foot level.

In the event of a breakdown in the radio or cable link from London, the station has its own film scanner on which cinematograph film can be televised. The range within which consistently good reception of the programmes broadcast by the Sutton Coldfield station is expected to be about 50 miles, varying from place to place and dependent on the presence of high ground between the station and the receiving point.

The picture quality radiated will be in no way impaired by the relay from London, and viewers will be able to enjoy entertainment equal in every respect to that enjoyed by viewers in the London area.

The combined control desk for the sound and vision transmitters.

Mullard

PIONEERS IN ELECTRONICS

The science and practice of electronics doubtless commenced with the first application of the thermionic electron tube—familiarly known as the "valve". The name of Mullard was closely associated with the early developments of the valve and Mullard was one of the first in the world to manufacture valves commercially. During the first World War Mullard Valves were used extensively by the Services, particularly the Mullard Silica Transmitting valves supplied to the Admiralty. Then, as now, Mullard Silica Valves were famous for their long life and high efficiency.

Early radio experimenters remember affectionately their first valve — carefully nursed and wrapped in cotton-wool—which in a majority of cases was the famous Mullard "ORA". Those letters represented "Oscillates, Rectifies, Amplifies"—one valve type for all purposes. Today, the Mullard range of valves includes a highly-developed specialised type for every conceivable application in science, industry, defence and entertainment.

In the television field, too, Mullard was (and remains) right out in front. The late John L. Baird is recognised as the "father" of practical television and most of the special tubes and valves he required were developed and made by Mullard. From that beginning Mullard has become England's leading source of electronic tubes for television and special defence applications.

There is hardly a field of application for electronics with which the name of Mullard is not intimately associated. In all modesty, Mullard can truly claim the title "Pioneers in Electronics."

In the field of electronics—"Communicate with Mullard"

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Mullard

LEISURE TWENTY YEARS FROM NOW

How will you amuse yourself in twenty years? Are leisure and pleasure the same thing? Our correspondent gives his typically stimulating ideas on the subject.

by Professor A. M. Low

TWENTY years ago we were talking about a 48-hour week as something of a dream to be realised. Today it is a 40-hour, five-day week. Twenty years hence shall we be talking about a 30-hour week? It may not have come to that, for there are obvious limitations on the indefinite reduction of working hours. But we may be certain that unless there is a major catastrophe we shall be enjoying shorter working hours in better conditions, and that will give everyone more leisure.

For several decades these new long hours of leisure are likely to present many people with difficult problems to face. In the past it has been only a very small, select class in any civilisation which has enjoyed real leisure. The world has never before known a society in which the majority of people were free to use the greater part of their lives as they liked.

Many will undoubtedly find difficulty in employing their leisure profitably or even happily, and I foresee that well-meaning attempts will be made to "organise" their free hours for them, especially in the case of young people.

These attempts will lead sooner or later to revolt and the realisation that, just as people must have the vote before they can learn to use it, so people can learn how to use their leisure only by being given it to play with as they wish. "Organised" leisure is a contradiction in terms.

BOOM IN SPORT

The new leisure will lead to a boom in "sport" which is already beginning to be apparent. We may anticipate some interesting developments before twenty years have passed.

For fifty years sport has become more and more "scientific," and we have attempted steadily to reduce the element of chance. We are no longer content that the movement of a ball should be influenced by a worm-cast or a flaw in the material of which it is made; so we poison the worms, select the material scientifically, and carry out tests on the ball before using it, as exact as those on an aeroplane part.

Our ancestors thought "spots" on a cricket pitch were part of the game, but we invoke the whole science of horticulture to eliminate them.

We are no longer content to accept the verdict of judges dependent upon the comparatively easily deceived human eye, so we install special cameras at the finishing post to record what actually happened.

I could give a hundred examples of how science has influenced our games recently, from the "new" golf ball—ballistically designed and X-rayed—to the studying of the laws of heredity to get better racehorses and greyhounds. Mathematicians are even engaged to take some of the gamble out of football pools with permutations and combinations.

We must expect this trend to continue. There has been argument in Australia about the verdicts of cricket umpires. We may see the invention and adoption of an "automatic umpire," based on radar principles, which would infallibly record the course of the ball!

Fantastic as it may seem today, in fifty years we may have "robot" jockeys for horse-racing. Since they would eliminate the "human element," they would make horse races a real test of the ability of the horses. Such a robot, based on electronic devices, has already been experimentally used.

NEW SPORTS

In the last twenty years we have seen the introduction of several new sports, and we must expect yet more during the next twenty years. The new sports are likely to appeal, like dirt-track racing, through a combination of scientific skill and personal courage. Dirt-track racers have to be concerned with such things as fuel values and sparking-plug design as well as the physical task of controlling a machine.

One of the new sports that might develop as a spectacle is model-car racing. During the last few years model cars less than 18in long and running literally on a thimbleful of fuel have achieved speeds of over 70 mph. I can foresee that this sport, developed by a promoter, might become a popular spectacle and, incidentally, be of considerable value to motoring generally.

The same applies to model aeroplane racing. Because of the great distances that have to be covered by a modern plane, aeroplane racing has restricted possibilities as a spectacle. But model aircraft, radio controlled, could be flown in a comparatively small area and provide the test of scientific skill as well as the competition which modern spectators demand.

Sport and organised amusement are already major industries, and we must expect them to develop. In the cinemas and in television we shall get not only "three-dimensional" full color, but also, perhaps, appeals to other senses as well. Experiments have been conducted with "scenties," and we may yet use perfume as a "background" to the pictures on the screen in much the same way as music is now used. It will even be possible to have "feelies." The spectator simply plugs into a socket on his seat and is electrically stimulated so that he not only sees, for instance, a silk dress, but actually gets the feel of it.

HOBBIES

But leisure cannot be devoted wholly to being amused. Obviously, men and women will have a spend a good deal of their "spare time" amusing themselves. Here I anticipate the majority of people devoting themselves to what we now call "hobbies" with such enthusiasm that they virtually become secondary occupations. They will have the time to give really serious attention to their gardening, rabbit-breeding, book-collecting, or whatever it may be.

I believe that we shall have to revise our ideas of education so that a child leaves school equipped with the basic knowledge not only to learn how to earn his living, but also how to use his spare time. The country should become very much richer for this. In twenty years we may expect a very great increase in the number of amateur theatrical, musical, literary, and similar societies doing really serious work.

Those whose tastes do not lie in the direction of the arts will find equal opportunities in the sciences. Most sciences have become extremely complicated and specialised, so that the "amateur" would appear to have little opportunity.

But, in fact, there are great fields which offer better opportunities to the amateur than the professional, especially in the so-called "social sciences." In many cases progress can only be made by the collection of material over a wide field, and it is here that I shall expect the amateurs to play an important part.

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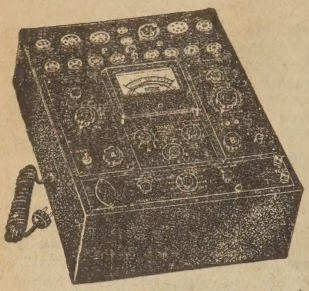

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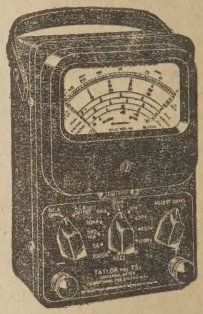
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

PRICE £39/17/6 Plus sales tax.

IMMEDIATE DELIVERY

MODEL 75A



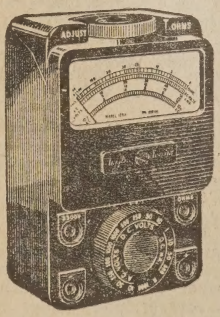
This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

PRICE £19/15/- Plus sales tax.

MODEL 120A POCKET MULTIMETER



RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

DIMENSIONS: 4⅞" x 3⅛" x 2"

PRICE £9/17/6 Plus sales tax.

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CONES OF SILENCE FIGHT NOISE

NOISE, the arch-enemy of man's well-being and efficiency, can be converted into heat and dissipated by an ingenious functional sound absorber developed at RCA Laboratories, Princeton, NJ.

These units, sometimes called "cones of silence," were developed by Dr. Harry F. Olson, director of the Acoustical Laboratotry, to solve special noise problems in the Laboratories. More recently they have been made available to industry by a leading manufacturer of building materials.

Each absorbing unit consists of two 14-inch cones, made of pressed wood pulp. The cones are fastened together base-to-base by a light steel band, and suspended from wires strung over the area to be soundproofed.

NOISE LEVEL GREATLY REDUCED

Whereas most materials used for sound absorption represent a compromise, in that they serve that purpose and also act as a wall or ceiling covering, the sole objective of the "cones" is to soak up clatter. Since the cones are not designed to do two things at once, their absorption efficiency is twice that of conventional materials.

Originally, the Olson devices were developed specifically to alleviate very bad noise conditions in the cabinet shop and drafting room of the Laboratories. In the former, the din created by circular saws,. band saws, hammers, and planers was excessive; in the latter, echoes and reverberations made concentration by personnel difficult. Both rooms have truss roofs, with skylighting and roof ventilation. Acoustical ceilings not only would have been extremely costly, but would have impaired the lighting and ventilation.

Installation of the absorbers reduced the noise level more than sixty per cent in each room, with a cone suspended at a height of ten feet for every five square feet of space.

In many instances it is not advisable or possible to install sound absorbing materials on ceilings or walls because of cranes, pipes, wiring, and other necessary facilities, &c. The great flexibility of the absorbers permits their use in many such situations and at a reasonable cost.

The absorbers are inexpensive and easy to install. In one instance three men, without previous experience, equipped a room having 1500 square feet of floor space in less than two days.

The absorbers operate on a principle of acoustic resistance, in which the acoustical energy—or noise—is converted into heat energy. This conversion takes place when air is forced through very narrow passages, such as are found in the fuzzy surface of the "cones."

It is believed that functional sound absorbers may undergo considerable improvement, whereas conventional materials, under development for 20 years, appear to have reached a point where actual results approach their theoretically possible values.

Installation of cones of silence in this carpenter's shop reduced noise by 60 per cent.

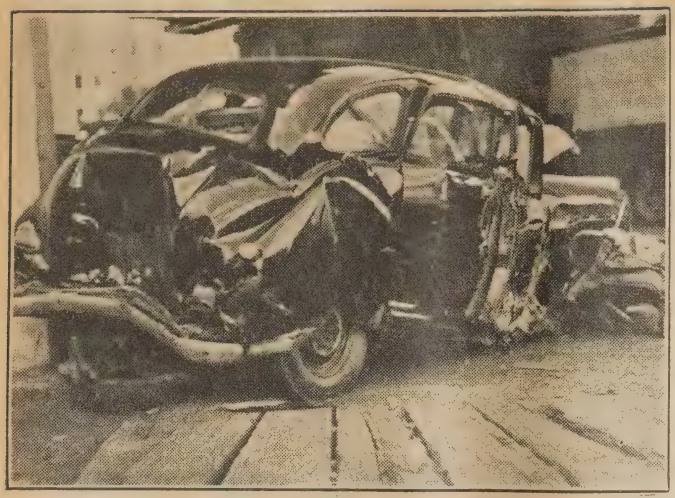
One of the penalties we have paid for mechanical advance is a vast increase in noise. The problem of reducing noise and its effects on those who work near it is a serious one, for efficiency is greatly reduced where noise is abnormal. The device described here was designed by a world authority on acoustics.

☆

Here are two cones which are clamped together at their outer edges to form one silencing unit.

☆

METEORS, often called falling or shooting stars, are pieces of stone or iron that enter the atmosphere and burn, heated by the friction of air.



This car was probably braking hard to reduce its motion when the accident happened. Kinetic energy stored in its mass was enough to smash it to pieces. An unhappy lesson, but an important one!

THE ENERGY OF MOTION

The energy stored up in moving objects can be colossal. Watching a big steam engine at rest one wonders how it can ever move its great bulk. To see it flying along at 60 m.p.h. the wonder is that it can ever be stopped. Both operations however can be accurately calculated and controlled.

SINCE motion plays such a major part in our daily lives it is the purpose of this article to explain, as simply as possible, some of the laws which govern this important subject. Not many people give much thought to physics as it is such a dry subject. We tend to just plod along without worrying about the whys and wherefores of everything.

Newton's Laws of Motion do not seem to have much practical bearing on how many hours of work we have to do a day or what will win the first race on Saturday. The price of gas and electricity or cigarettes and beer seems to be remote from the laws of friction.

RULES OF PHYSICS

Yet all these matters are affected by the rules of physics, for motion and friction are the two forces which are combined to affect the running of the machines at our place of work or the running of a horse in a race. The production of gas and electricity are governed to a large extent by the efficiency of machinery. The manufacture of beer and cigarettes is likewise affected.

Trains, trams, motor cars and aeroplanes depend on motion. Even the early morning milk cart will fail to give satisfactory service if the axle is not well greased or the horse is not well shod to counter the friction of the bearing surfaces.

The two most important kinds of energy met with in mechanical things are kinetic energy and potential energy. These are the two special kinds of energy from which the power to perform acts of motion are derived.

If we neglect the means by which an object is moved we can consider kinetic energy as the energy stored up in a moving object. Once an object is moving it is capable of performing some work.

The amount of energy which a moving object contains depends on the mass and the velocity of its movement. By mass we do not mean size, because two objects can vary greatly in size while possessing the same mass because they contain the same amount of matter.

A piece of lead one foot cube weighs about 700 pounds. A load of cork to weigh this much would be very much larger in size than the cube of lead, yet they are said to contain the same mass.

Immediately a mass is given motion, therefore, it is capable of doing work by reason of the kinetic energy stored within it. This is the reason why some machines are provided with a flywheel. This wheel, by reason of its mass, will continue to revolve after the driving force has been removed. The kinetic energy keeps it moving and the length of time it continues to revolve depends on its velocity at the time the driving force was removed.

The heavier the wheel (mass) the longer it will revolve. It will require a greater driving force to start it, but once started it will continue until the friction of the bearing surfaces brings it to a stop.

MOVING CAR

The importance of kinetic energy can be seen in its effect on the braking of a motor car or truck.

A five-ton vehicle travelling at 60 miles per hour has five times the kinetic energy of a one-ton truck travelling at the same speed. Some people have found this out, but they were unable to tell about it after being hit.

What happens to the kinetic energy when a truck doing 30 miles per hour increases its speed to 60 miles per hour? The energy is not increased twice but FOUR times as much. Kinetic energy is proportional to THE SQUARE OF THE VELOCITY.

If the brakes of your car can pull you up in 30 feet at 20 miles per hour they will require 120 feet to pull you up at 40 miles per hour and about 270 feet at 60 miles per hour.

These figures have been proved by practical tests, and as most car brakes are not one hundred per cent efficient these distances could be safely increased.

A driver of a car would do well to have the figures well in mind.

At 40 miles per hour a distance of 120 feet is a long way to travel if an emergency arises.

POTENTIAL ENERGY

In these days of petrol shortages kinetic energy plays a great part in petrol consumption. If a car is driven at 40 miles an hour the kinetic energy stored up is sufficient to carry the car along for a distance of about a quarter of a mile on a level road after the clutch has been disengaged. If the driver has to apply his brakes to stop, most of this energy is wasted in the brake mechanism.

The second type of energy mentioned, POTENTIAL ENERGY, can be termed energy of position.

A spring can be used as a good illustration of potential energy. A coiled spring is capable of doing work. It has work stored in it.

When the spring is compressed or stretched we do the work that is stored up in the spring. The amount of work we do is recovered when we release the spring.

The same thing happens when a motor car is pushed up a hill. There is potential energy in the car and the work required to push it up the hill is recovered when it rolls down the other side of the hill. We don't get ALL the work back because friction prevents this.

Friction prevents us getting all the work out of a machine which we put into it. But if this friction is reduced to proportions small enough to be neglected, the total energy of kinetic plus potential remains constant.

Thus kinetic energy can change into potential energy and vice-versa, but the total energy will always remain the same. This principle is termed the Conservation of Energy.

It may not seem important at first, but it explains many everyday things.

ENERGY CONSERVATION

Take a clock-spring. As explained above, the unwound coiled spring contains potential energy, inasmuch as it is capable of doing work. If, now, the spring is wound up, it immediately begins to give back the work put into it, and in unwinding, there is a release of kinetic energy from the moving clock wheels.

The same thing happens to a motor car as it coasts down a hill. Coming up the hill the energy is potential; on coasting down the other side, the energy changes to kinetic as the car gathers speed.

This rule also shows that if you are in a light car going at the same speed as a heavy car abreast of you on the crest of a hill (which you should not be doing unless you want to do a term in gaol, hospital or the cemetery), and you both disengage the clutch at the same moment, you will both still be abreast of each other at the bottom of the hill.

A heavy car will NOT coast faster downhill than a light car, no matter what you hear to the contrary.

THE BIG DIPPER!

Conservation of Energy is made use of in those awful elevated railways seen in some amusement parks. They are sometimes known as Big Dippers. Such a term is often applied to those who ride on them. I had a ride a little while ago. It's very thrilling.

In these affairs, the car is mechanically pulled to the top of the first drop and then released. Coming to the top the energy is potential. Going down the energy changes to kinetic as the car gathers speed. It again becomes potential at the top of the next incline, and changes again to kinetic, and so on, to the end of the journey.

As friction plays such an important part in mechanics, it is well if we consider some of the peculiar properties of this mostly unwanted factor.

One of the chief types of friction met with by the car-owner is the dry sliding type of friction which takes place between the road and the tyres.

This type of friction is mainly caused by the small hollows and hills of the rough surfaces interlocking with each other. These hills and hollows are present in even the smoothest surfaces. At a constant speed on a level surface, less force is required to keep an object moving than was required to start it sliding.

This is because at rest the irregular surfaces are interlocked with each other, while in motion they hop over.

by Calvin Walters

The area in contact with the surface has not much to do with the friction. What matters is the weight pressing on the surfaces.

For instance, a piece of stone weighing one pound would require the same force to slide it when laid on its end as the same piece of stone would require laid flat. The friction, however, would be doubled if the piece of stone was two pounds weight.

Here again we see the results of these rules can be applied to the driving of a car.

Take the latter rule referring to area of contact. This would mean that on a dry road the small tyres of the baby car will skid no more than the large balloon tyres fitted to the same car.

Also, the same car filled with passengers will give a better non-skid contact than the empty car.

If you have to stop quickly, don't apply the brakes hard enough to cause the wheels to slide, because, according to the rules, it requires less force to keep an object moving than it does to make it slide. Thus, if the car is made to slide, the brakes lose a lot of their effect.

The same holds when travelling through mud or sand. Any motorist who has experienced this will know that once the driving wheels begin to spin there is not much chance of continuing a forward movement. It is always better to travel slowly in low gear.

Another peculiarity of surfaces is that the friction between two unlike surfaces is less than between two like surfaces.

Engineers know this very well, and make the bearing surfaces of crankshafts, &c., of unlike material. Steel crankshafts usually run in bronze bearings.

The reason for this appears to be that the surfaces of two unlike substances would be unlikely to be similar. In other words, the hills and hollows would not register, and there would be less tendency for interlocking to take place.

The study of motion is a very large one. It would require many more pages to describe the effects on our living of such physical laws as the laws of Momentum, Gravitation and Equilibrium, and all the other "rules and regulations" which Nature has imposed.

It is to be hoped that the above short treatise will have thrown some light on matters closely related to the motorist in particular and that he will benefit therefrom by the information given herein.

New Method Generates Coal Gas

FUEL gases from coal as it lies underground in its natural seams have been successfully obtained by sending an electric current through the coal.

The process consists of making drill holes from the surface into a seam of coal lying below. Iron pipes are inserted into the holes to serve as electrodes. Connected with the electrodes is a series of pipes a few feet above ground through which the gas flows when it is generated.

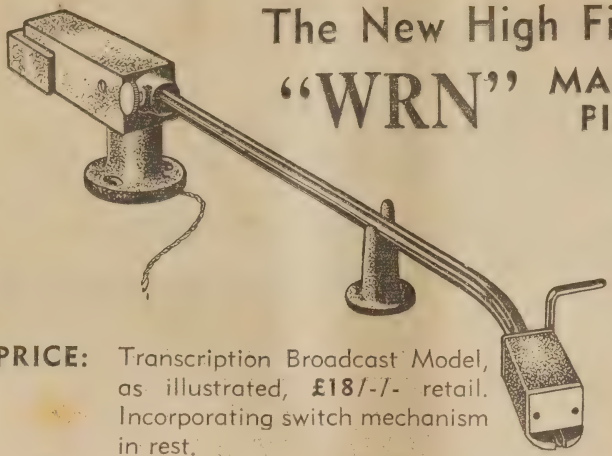
A current of considerable voltage controlled by a water rheostat, is sent down through the electrodes into the seam. In the process of passing through the coal and overcoming its electrical resistance, the coal is heated and begins to give off oil-saturated gas. This gas comes to the surface through the pipes that serve as electrodes. These pipes are 20 to 40 feet apart.

After the coal bed becomes sufficiently heated so that it will burn and yield other gases, the electric current is stopped and air or oxygen is pumped into the coked and porous coal seam to sustain further combustion. This continues the supply of gases from the actual gasification of the underground coal.

The gases produced by this so-called electrocarbonisation process can be used as raw material from which to make synthetic gasoline, or can be converted into a heating fuel. The gas produced is similar to the coke furnace gas of surface plants. Field tests were preceded by laboratory experimentation during which it was proven that coal can be turned into gas by an electric current.

Laboratory investigation with oil-sand has resulted in the production of crude oil, as well as gas.

Two holes are sunk into the coal seam, and fire started in one by use of an incendiary bomb. Air under pressure is forced in to feed and spread the fire, and the gases of combustion are driven by the same air pressure to the second hole from the top of which they are captured.



The New High Fidelity "WRN" MAGNETIC PICK-UP

PRICE: Transcription Broadcast Model, as illustrated, **£18/-/-** retail. Incorporating switch mechanism in rest.

£15/10/- retail (Standard Domestic Model) for 10" and 12" recordings. Incorporating all the important features of a perfect reproducer.

FEATURES:—

WIDE FREQUENCY RESPONSE: Plus/minus 2 db to 9000 c/s, with no resonant peaks.

PERMANENT STYLUS: Gives long service on any type of records, but can be simply replaced in 60 seconds.

LOW NEEDLE PRESSURE: Only ¾ ounce, coupled with low lateral impedance, record wear is negligible. A commercial pressing is unmarked after 500 playings.

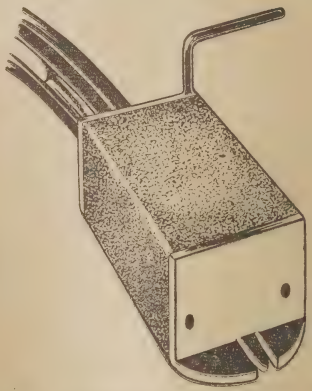
VISIBLE STYLUS: The stylus is in full view, so essential for groove spotting.

INSTRUMENT TYPE ARM: Designed for minimum tracking error — no resonances—height adjustable for various turntables. Maximum tracking error, 3½ degrees.

ACCIDENT PROOF: Accidental dropping of pick-up on disc is unlikely to damage stylus or disc, even instantaneous types.

OUTPUT: 12.5, 50, 200 or 500 ohm heads — 30 dbm; high impedance head for grid circuit 55 mV. (unequalised).

CUEING: Record rotation may be reversed for cueing without damage to pick-up or disc.



● Enlargement showing pick-up head and stylus.

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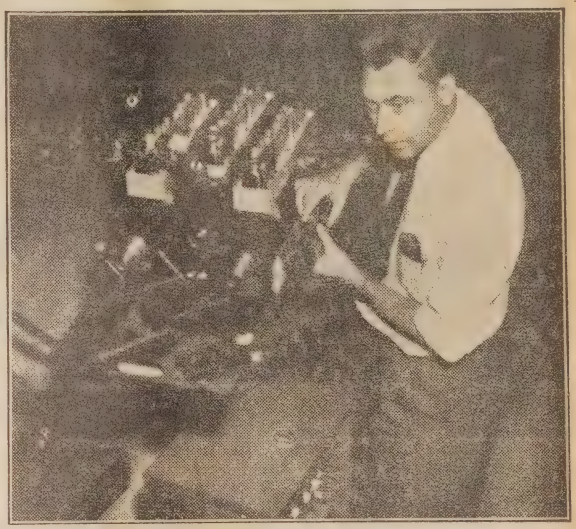
Technical Review

HOW IT WORKS— COLOR TELEVISION BY RCA

The whole future of television may be changed by the impact of color. It has virtually brought the industry in America to a standstill while its influence on present and future allocations are studied. In this article we give RCA's Dr. Euphoni's story of how the RCA system operates. It is the major electronic system in USA, as against the Columbia system which uses revolving discs to break up the colors.



The color television camera with cover removed showing dichroic mirrors (in front) and some of the electronic controls.

FIRSTLY, the RCA color television system is a compatible system. This means that present television receivers can receive color programmes in black and white without any modification. Also, when a broadcaster shifts from black and white transmission, the viewer of an existing black and white receiver is unaware of the shift.

On the other hand, a viewer of a new color set receiving programmes in color, will, when the broadcaster changes from color to black-and-white transmission, see black-and-white pictures without making any changes in his receiver.

"The question of compatibility is of great importance not only to the present owner of a black-and-white receiver, but may very well be fundamental to the economics of a color television broadcasting service. In considering the public interest, it is necessary to take into account these economic factors, because the public cannot be served unless the broadcasters are able to render a commercial service.

"With a compatible system a broadcaster first starting color schedules is automatically assured that he will retain his full potential audience on all the receivers in his service area, both black-and-white receivers and new color receivers. The economics of the television broadcasting industry appear to be such that regular color broadcasting service might be seriously delayed if the broadcaster must sacrifice circulation, and therefore revenue, in order to provide color transmissions.

INEXPENSIVE

"With a fully compatible system, however, the broadcaster can change at will, either from color to black-and-white or the reverse, without disturbing the viewers of either the existing receivers or color receivers, and without requiring adjustments to either type of receiver. This means no loss of audience at the start or later, which will no doubt be an important factor for some time, because it is probable that many programmes will be transmitted in black-and-white even when color becomes an established service."

Existing black-and-white television receivers may be converted to receive color pictures by various methods, as follows:—

1. By using a separate converter unit containing appropriate electronic gear and picture tube viewing arrangement of a ten-inch diameter size.

2. By substituting a new projection unit for the cathode ray tube in the black-and-white set.

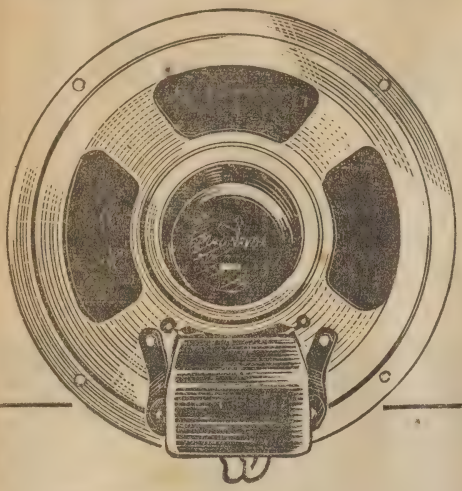
3. By adding one tube to the cathode ray tube in the black-and-white set and changing the three-color signal to a two-color signal to be viewed on the two-cathode-ray-tube combination.

HOW IT WORKS

The color camera in the studio is equipped with three separate tubes. Each of these pick-up tubes, equipped with an appropriate color filter, receives one —and only one—of the primary colors, which in television are red, blue and green. In transmitting a color picture, these colors are electronically "sampled" in rapid sequence and combined. The combination is then transmitted as a unit over a standard television transmitter.

At the receiving end, the single television signal is fed to an electronic arrangement which is the inverse of the sampler at the pick-up. The combination is separated and a signal representing each color goes to a tube in the receiver which reproduces a picture in that particular color. The three separate colors are then viewed simultaneously as a single, complete color picture.

One of the fundamental characteristics of the system is the application of "time multiplex transmission,"



The New Magnavox Centre Pole Permagnetic Speakers

Available in 6", 8", 10", 12" with two magnet weights and with full range of matching transformers.

Prices:—

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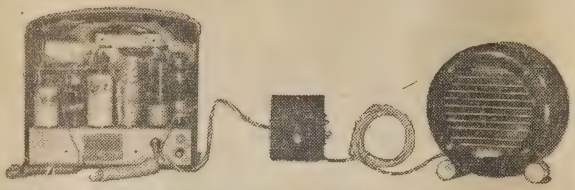
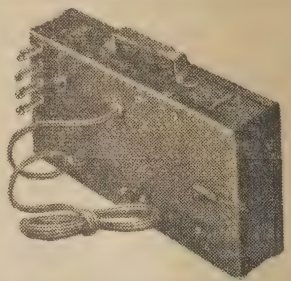
Model 6P1	£1/19/11	Model 12P2	£2/15/3
Model 8P2	£2/-/-	Model 12P1	£2/17/9
Model 8P1	£2/2/8	Filter Chokes	7/1
Model 10P2	£2/11/8	Transformers	15/5



THE NEW AEGIS EXTENSION SPEAKER & ADAPTOR

Enables easy fitting of an extension speaker to any existing receiver. Speaker in walnut plastic cabinet 65/9; speaker in cream plastic cabinet 68/-; cabinet only, walnut 29/9; cream 32/-; adaptor unit 42/6.



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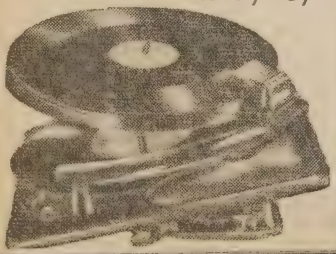

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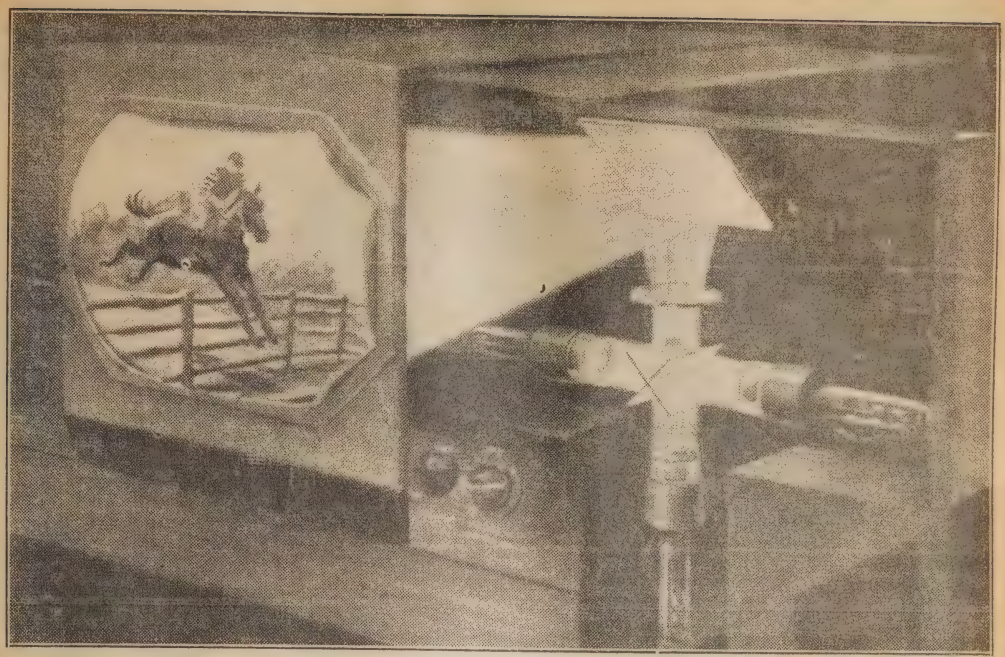


The color converter using small projection Kinescopes and refractive optics.

which has been adopted and applied to television from the art of radio telegraphy. Other innovations are the "electronic sampler" and "picture dot interlacing."

The electronic sampler, which is described as a new and outstanding engineering development, functions with microsecond precision in sampling the colors. From the sampler the signals, representing the three primary colors, are fed to an electronic combining device. Standard synchronising signals from the synchronising generator are also applied at this point, and the principle of "mixed high frequencies" is also utilised.

COLOR SAMPLING

Each color is sampled 3,800,000 times a second—for the three colors a total of 1,400,000 samples a second. The green signal is sampled, and less than nine hundred-millionths of a second later the red is sampled, and then the blue. This means that the signals of each color are transmitted at an approximate rate of one every four-millionth of a second. When viewed on the screen of a receiver the recurrence of the signal is so rapid that color appears to be constant—giving a high-quality picture without flicker or color break-up.

The three color signals from the camera are combined in an "electronic adder," and then are passed through a band-pass filter. The output of this filter contains frequencies between 2 and 4 megacycles, with contributions from each of the three color channels. The signal at the output of the band-pass filter is known as the "mixed-highs signals." These mixed-high frequencies are fed to an "adder" which is already receiving signals from the sampler and from the synchronising generator. The composite signal which comes out of a smoothing filter is applied to the modulator of the transmitter.

"We have demonstrated," continued Dr. Engstrom, "that the mixed-highs procedure is successful and satisfactory in a wideband simultaneous system. The sampling process by itself is sufficient to carry high-frequency components of each color signal so that, when combined, the resulting band width is below 4 megacycles (the sampling frequency determines the highest frequency which will be passed). However, the choice has been made to sample for the lower half of the video band (up to 2 megacycles) and to use the mixed-highs principle for the upper half of the video band, because this has technical advantages.

BLACK AND WHITE

"The radio-frequency circuits, the picture intermediate-frequency amplifiers, the second detector, the sound intermediate-frequency amplifiers, the discriminator, and the audio circuits are identical with those of a conventional black-and-white receiver. The composite video and synchronising signals from the second detector enter an electronic device called the 'sync separator,' which removes the video and sends the synchronising pulses to the deflection circuits and to the sampling pulse generator. The sampling pulse generator utilises the trailing edge of the horizontal synchronising pulse to actuate the receiver sampler in synchronism with the transmitter sampler.

"The signal from the second detector also enters the sampler. It is a composite signal. An electronic commutator samples the composite signal every 0.0877 microsecond, producing short pulses. The amplitude of each of these pulses is determined by the amplitude of the composite wave at that particular instant.

"The commutator feeds these pulses into three separate video amplifiers which, in turn, control three cathode-ray tubes or kinescopes having appropriate color-producing phosphors."

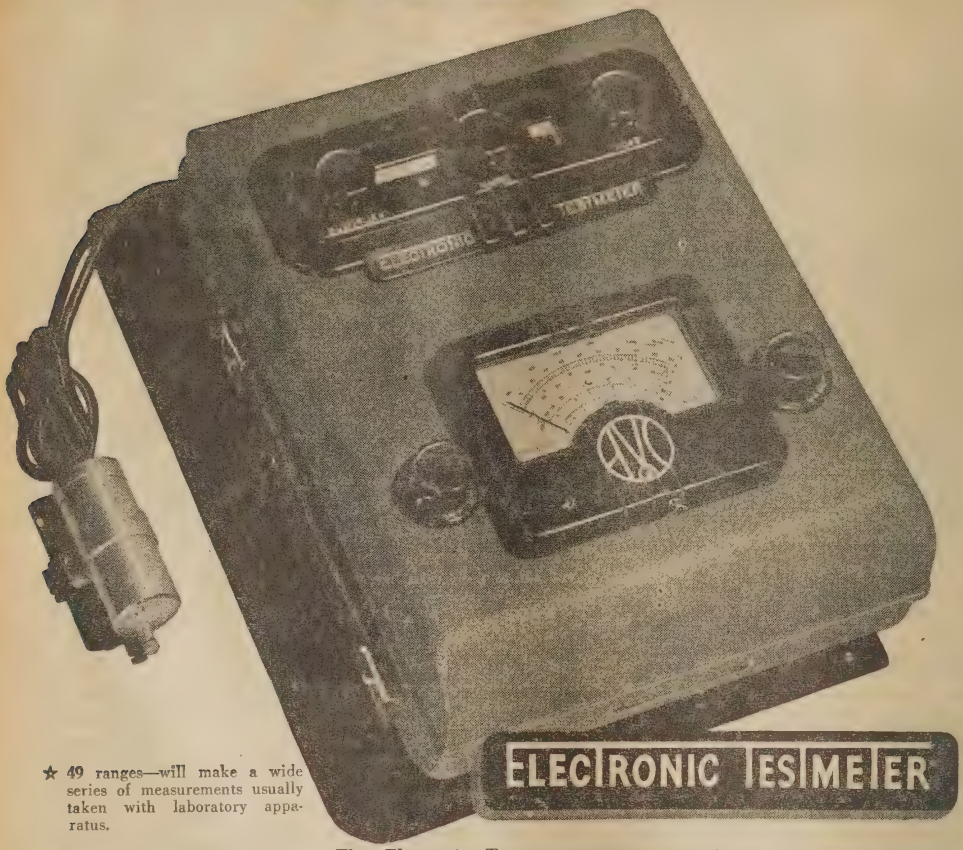
Dr. Engstrom summed up the characteristics of the new RCA color system as follows: (1) 6 megacycle channel; (2) fully compatible; (3) 525 lines; (4) 60 fields per second; (5) field interlaced; (6) picture dot interlaced; (7) 15 color pictures per second; (8) time multiplex transmission; (9) all-electronic.

A HINT FOR SAWING THIN WALL TUBING

TO saw thin-wall tubing quickly and easily, fit two blades into the hacksaw, staggering the teeth. The latter is done by elongating one hole in each blade with a rattail file, the elongated holes being made at opposite ends of the blades. The staggering prevents the teeth from hooking on the edge of the thin metal and permits the blades to cut like a file.

In addition, if one of the blades is reversed, the saw will cut on both strokes, speeding the job considerably.

another AVO achievement



★ 49 ranges—will make a wide series of measurements usually taken with laboratory apparatus.

★ Measures most exacting A.V.C. requirements: sensitive D.C. voltage range measures down to 2.5 mV with an instrument resistance of 11.1 megohms.

★ A sensitivity usually associated with a delicate galvanometer is given by the use of a thermionic Millivoltmeter circuit.

★ Insulation measurements up to 1,000 megohms without externally applied voltage.

☆

The Electronic Testmeter measures up to 10,000 volts D.C. with negligible current drain; makes accurate R.F. voltage measurements to frequencies higher than 200 mc/s and D.C. current measurement to less than 0.25 uA.

These facilities make it extremely useful in Television, Radar and Cathode Ray Tube applications. Also, the requirements of most medium power audio and radio frequency industrial equipment are fully covered with the measurement of up to 2,500 volts A.C. over a frequency range in excess of 200 mc/s. It is robust and stable, with an exceptional ease of handling.

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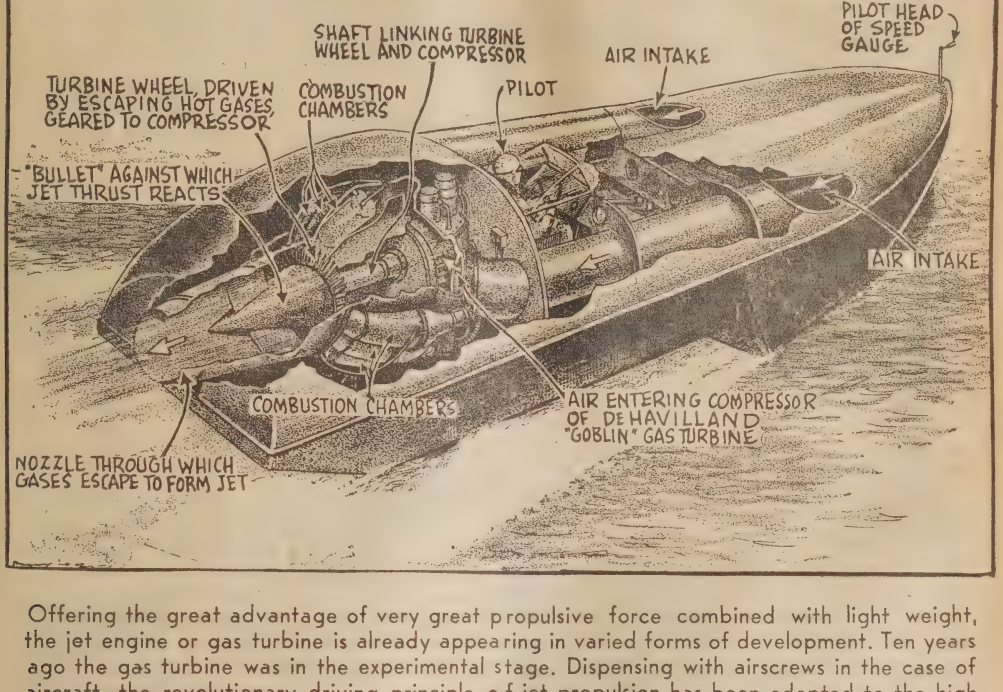
AV.2

HOW IT WORKS-JET SPEED BOAT


SHAFT LINKING TURBINE WHEEL AND COMPRESSOR
PILOT HEAD OF SPEED GAUGE
AIR INTAKE
TURBINE WHEEL DRIVEN BY ESCAPING HOT GASES GEARED TO COMPRESSOR
COMBUSTION CHAMBERS
PILOT
"BULLET" AGAINST WHICH JET THRUST REACTS
AIR INTAKE
COMBUSTION CHAMBERS
AIR ENTERING COMPRESSOR OF DE HAVILLAND "GOBLIN" GAS TURBINE
NOZZLE THROUGH WHICH GASES ESCAPE TO FORM JET

Offering the great advantage of very great propulsive force combined with light weight, the jet engine or gas turbine is already appearing in varied forms of development. Ten years ago the gas turbine was in the experimental stage. Dispensing with airscrews in the case of aircraft, the revolutionary driving principle of jet propulsion has been adapted to the high speed motor-boat. A screw is unnecessary and the propulsive force of the engine can be applied directly.

CONSTRUCTIONAL details of the late Sir Malcolm Campbell's Bluebird II, the first jet-propelled very high speed motor boat of its type, are shown in this diagram sketch.

It will be seen that air for the engine is taken in at the point where the streamlined canopy of the boat begins to rise towards the pilot's cockpit.

The air is led back through pipes to the de Havilland Goblin jet engine, which is located in the rear of the boat. The air-compressor forces the air under pressuure to the combustion-chambers, of which there are 16. The combustion-chambers are arranged radially, each pointing slightly inwards so that the exhaust gases will play on the turbine-wheel.

The turbine-wheel is connected by a shaft to the air-compressor.

THRUST CONE

When the exhaust gases have passed through the turbine, they are directed to a cone before they escape through the rear nozzle of the jet-pipe.

The jet-thrust reacts against the bullet-shaped cone, driving the engine—and, with it, the boat—forward at great speed.

Use of a pure jet engine such as this is limited, being confined, to all practical purposes, to military and special civil aircraft and high-speed motor boats. The gas-turbine is proving very adaptable, however, and, instead of using the power in the form of a jet, it is possible to harness it to other forms of drive where this is desirable.

GAS TURBINE

It is possible to absorb all the power of the gas-stream in the turbine-wheel, reducing the actual jet to a comparatively cool, low-speed exhaust. This is the form that the gas-turbine will take in motor vehicles.

Such a power unit is, in fact, similar to a steam turbine except that it dispenses with boiler water-feed pumps, condenser, furnace, and many other weighty items incorporated in steam power plants.

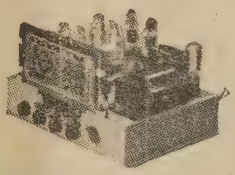
The pure jet engine, while it produces terrific thrust and is of particular value in giving very high speeds, is not economical in fuel. Thus it will be used in marine work only for special purposes. The gas turbine adapted for screw gearing is light in weight and cheap to run, however, and it is already appearing in merchant ships.

In the marine gas turbine, the air drawn into the compressor is first passed through a radiator heated by the exhaust gas from the turbine. In addition, two or more compressors may be fitted, while a series of turbine-wheels extract all the power from the gases before they are discharged through the funnel.

It has been found that, although the turbine can be successfully geared direct to the propeller-shaft of the ship, it is better for the turbine to drive an electrical generator, from which power can be fed to two or more motors attached to the propellers. This arrangement gives greater efficiency in operation, since it means that in the event of a motor failure the ship can continue the voyage, at reduced speed, while repairs are made, and the motors are under direct control from the bridge.

Get YOUR Kit from the Kit-Set SPECIALISTS

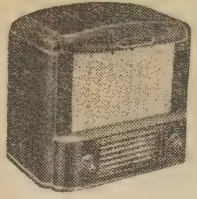
Yes, Electronic Parts Pty. Ltd. specialise in Radio Kits and can supply whatever you fancy, be it an R. & H. Circuit, or one of our own designs. Check through this page and then send for our free descriptive leaflet and price list—the kit you want is here, or we can supply it. Vibrator Kits, A.C. Kits, Battery Sets, Portables, Mantel Models, Consoles, Radiograms—all are listed, from the beginner's one valver right through to the ultra high fidelity models. Only best quality components are used, every kit is guaranteed, is complete to the last nut and bolt, and prices are bedrock.

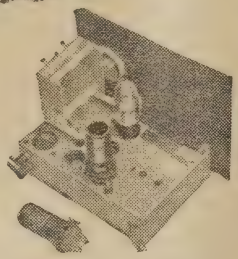


Little General

2 Popular Models

1946 A.C. D/W 4 valve kit with A.V.C.
1947 A.C. B/C 4 valve kit with A.V.C.
Both models in same leatherette covered cabinet.





1947 Senior Radiogram

High fidelity and ample power reserve with push-pull 807 output are features of this super 8 valve D/W A.C. receiver with R.F. stage.

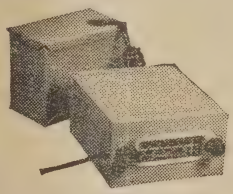
Electronic Parts Kit

In the famous Electronic Parts plastic cabinet and complete with valves, speaker, full building instructions, etc.

- 3 valve Triple Wave A.C. kit.

Beginner's 1 Valve Kit

Specially designed kit set for radio students and beginners, this B/C and S/W battery kit gives maximum instruction in set building and coil winding. Complete with all parts including headphones, valves, batteries, full building instructions, etc.

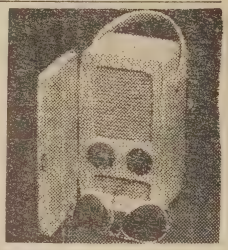


KARSET

This is the car radio kit you have been waiting for. Economical to run, and a first-rate performer, it will fit any car, irrespective of size or electrical system.

Carry Set

The latest in 4-valve battery portables. A.C. power supply available. The simplest possible portable to construct. Size 8" x 4½" x 4".



Handie Talkie (4 valve)

Uses all latest miniature components and is complete with cabinet, batteries, etc.

Handie Talkie (5 valve)

Same as above, but longer range through extra I.F. stage. Smallest 5 valve portable ever designed in Australia.

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PENTAGRID 4 & 5.
ALL BATTERY 5.
SENIOR PORTABLE
SENIOR A.C. POWER UNIT
MULTI-TALKIE
HANDIE TALKIE 4 & 5
PK4X PORTABLE
SPRINGTIME PORTABLE
PORTABLE POWER
SUPPLY 6/240
SUPERHET TUNER
INTERCOM SYSTEM
UNIT CRYSTAL SET
SLUMBER SET
METRO 4
CORNER SET etc, etc.

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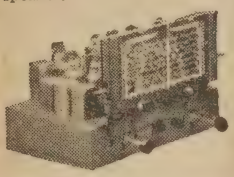
All kit enquiries and orders receive the personal attention of Mr. Don McEvoy, Radio Technician, who has a wide experience of kit construction. You can order your kit with full confidence from Electronic Parts Pty. Ltd.

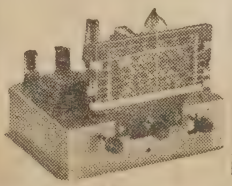
1946 Standard

7 valve D/W A.C. console with R.F. stage and push-pull output. Large, straight line dial and 12" permag. speaker.



1947 Advance

features straight line dial, Permag. speaker, 5 valves, D/W A.C.



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KIT-SET SPECIALISTS

NEWS AND VIEWS OF THE MONTH

Professor Einstein

THE biggest news of the month in the scientific world was undoubtedly the announcement by Professor Einstein of a theory and a formula which not only explain the essential secrets of gravity, but contain the general statement of principles upon which the whole structure of the universe might well depend.

The matter is so involved and requires such a special knowledge of the terms used that very few will ever be able to understand its full import.

To lesser men, whose knowledge and interest of the things that are is confined to those which lie within their capacity to understand and examine, Einstein's work will gradually achieve importance when, in the course of time, his new theory is applied to such things. Only through research and experiment, which will probably not reach completion for many years, will its truth and/or completeness be tested.

HUGE EVOLUTION

One thing seems certain, that the growth of the universe in a huge process of evolution points the way to basic functions which, because of their prime effect on that evolution, must be found as the guiding principles of what has resulted.

Not only is this a logical concept, but it makes some statement such as Einstein's inevitable, even supposing that some of his quantities fall short of the truth.

But when we remember the accuracy of his earlier "theories," which have now become a scientific byword, we are inclined to give him the benefit of the doubt in his latest effort of long-range scientific forecasting.

The fact that his latest theory is in reality a mathematical formula may seem strange to many who are apt to consider mathematics as a subject divorced from less concrete ethical and moral matters. But in reality, mathematics is merely a language — the "language of the universe," as someone has described it —and the scientist cannot but lapse into that language when he finds it the only way to express ideas which are too wide to be told in the language of everyday communication.

COMMON LAWS

Einstein has underlined yet another truth, that it is impossible to consider any one subject as a thing apart from another. It strikes a terrific blow at the great mass of dogma and mental bigotry which exists so sadly in much of man's thought. It shows the foolishness of thinking that so many of our problems can be worked out in nice, compact packages, safely tucked away in our minds as being the end of the matter.

The truth is that, until our thought processes have advanced to the stage where we can see our nicely cut-and-dried solutions as a self-confessed end to thought and the search for truth, we cannot hope to understand, even dimly, the evolution of that truth.

It is the tragedy of man's thought that so often he refuses to believe that to live through change and conflict is a natural order. And it is probably the world's great social tragedy that so many have fought mental and material wars to impose the results of their own limited ideas upon others who can see beyond them.

RADIO CROSSWORD PUZZLE, No. 29

ACROSS

1. Type of current.
4. Point at which reflected rays come together.
8. Send waves into space.
9. Directive antennas.
10. Likewise not.
11. External.
13. Type of rectifier.
14. Parts of speakers.
17. Images.
21. Ground connection.
22. Unit of light.
26. Greek symbol for efficiency.
27. Moving part.
28. Voltage.
29. Telegraphy signals.
30. Discharges.

DOWN

1. Unit of elastance.
2. Receiver.
3. Frontier.
5. Type of cable.
6. Network of stations.
7. Unit of inductance.
9. Tuning having little selectivity.
12. Large electric jug.
15. Unit of magnetising force.
16. Waves are propagated through it.
18. Metal in its natural state.
19. Decimal system.
20. Valve element.
23. Alloy composed of nickel, copper and iron.
24. Interference to reception.
25. Brings in station.

BELOW—LAST MONTH'S SOLUTION

C	A	T	H	O	D	E		D		B		M
	E				E		V	I	O	L	L	E
C	R	Y	S	T	A	L		P		E		R
	I		E		L		T	O	N	E		C
H	A	R	T	L	E	Y		L		D		U
	L		S		R		M	E	T	E	O	R
A		P		C				S		R		Y
S	H	R	O	U	D		C		T		M	
T		O		P		S	O	U	R	C	E	S
A		T	U	R	N		R		O		G	
T		O		O		V	O	L	T	A	G	E
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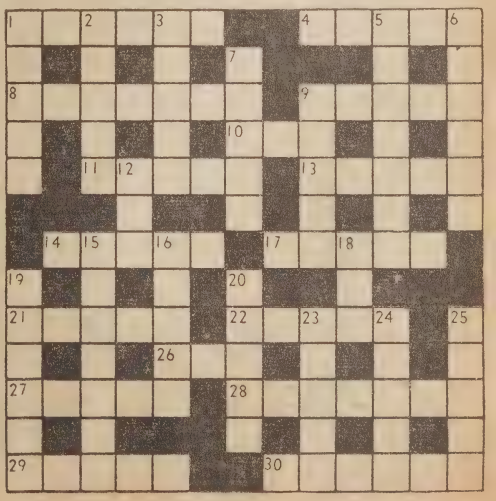

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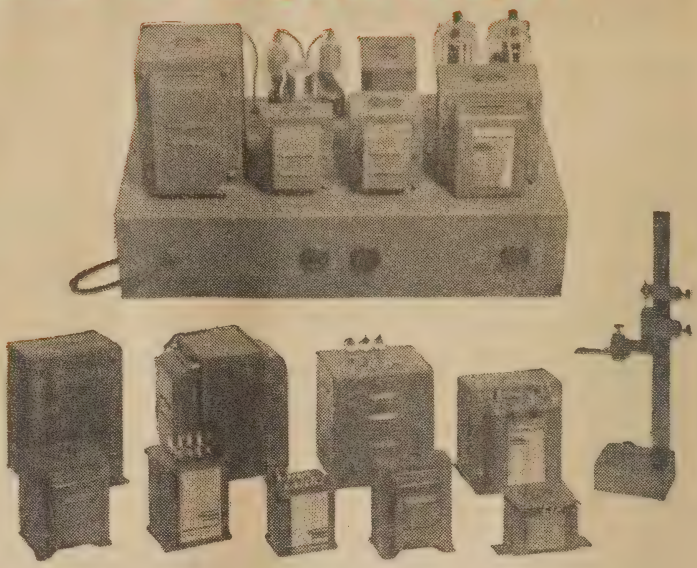
Matched Transformer **KITS** for all classes of Electronic Equipment



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Precision in Design and Construction

We are specialists in the design and manufacture of Communication Equipment, Industrial Transformers, and Chokes and Fluorescent Lighting Equipment.

Unlike most manufacturers in this field, we operate our own tool room, press shop and laboratory and this close integration of our internal organisation is of particular value to manufacturers using our products.

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- Output Transformers
- Swing and Smoothing Chokes
- Wide Range Audio Equipment
- Frequency Dividing Networks
- Power Transformers
- High Tension Plate Transformers
- Low Tension Filament Supplies*
- Heavy Duty Power Supplies
- Class B Driver Transformers

*Insulated for High Voltage if required.

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Artificial rain

DR. IRVING P. KRICK, of the American Institute of Aerological Research, says that push-button rain produced by chemical smoke sent up from the ground may be possible in the near future.

It will render obsolete the use of "dry-ice," which has been used successfully in experiments in Australia and abroad.

The new technique, which employs mobile silver iodide "smoke" dispensers, situated strategically on the ground, is estimated to have quadrupled the rainfall in a small Arizona area.

In dispensing the silver iodide from ground units, truck trailers haul the gear to the windward side of sloping ground.

It was found that the particles which caused moisture to collect in drops heavy enough to fall were sufficient in number to produce a cone which widened and finally reached a distance as much as 20 or 30 miles from the installation, down wind.

Each dispenser is thus capable of effecting precipitation in an area of about 240 square miles.

A single gramme of silver iodide powder contains at least 100 million million particles, each capable of collecting a raindrop.

Silver iodide costs about 20 dollars a pound, and one smoke unit consumes approximately two dollars worth of powder an hour.

The present silver iodide dispenser unit—admittedly experimental—includes an electric generator, a powerful smoke blower, and a unit in which the silver iodide powder drops from a small can on a plate heated by a blow torch. The heating vaporises the silver iodide.

F.M. Unpopular

ACCORDING to latest reports, FM broadcasting seems to be taking a terrible beating in the USA.

"Today," says a correspondent, "the path travelled by FM is haunted by ghosts of broadcasters who took a whirl in the new medium. The ten-year tally sheet shows scores of failures, a few minor successes. The outlook — more fatalities to come."

"You can put FM down as one of the commercial flops of the decade," says another.

The main trouble seems that in USA, the practice of running simultaneous programmes on AM and FM means that, as the advertiser pays nothing for the second channel, costs have run too high for the station.

Apparently the public just doesn't appreciate any of the advantages FM brought to them. In the eighteen months ending November, 1949, 220 FM stations ceased transmitting out of an estimated total of 1000. The mortality rate seems to be maintained. Many stations who obtained permits to operate never went on the air. It is reported that only a dozen stations now operating are making any money.

RIDING OUT THE STORM
Transformers are costly equipment—and there are few electrical units that have to take so many hard knocks.
Heat or blizzard, rain or electric storm, they continue to function for light and power for all types of electricity undertakings. Resistors — costing little — are not only necessary applications for effective operation, but they are important contributions to the long and efficient life of the transformer.
The particular process of manufacture to which IRC Resistors are subjected ensures protection from the elements in all conditions where PERMANENCE is vital, select I.R.C. Resistors, whether Metallized or Power Wire Wound, for which there can be no substitute.
There are I.R.C. Resistors for every electrical industry.
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Pick-up Performance

design and practice

Having completed a good deal of experimental work with modern type gramophone pickups in the past few months, we are able to present here some enlightening practical material concerning their application and design. It has been of great interest to observe how general theoretical considerations have been borne out in practice, and to form some conclusions which might help to understand more fully why pickups are made the way they are.

THE general requirements for a pickup have evolved over a number of years, and have become clearer and more stringent as recording technique has advanced. Let us review briefly the major considerations in pick-up design, and then consider how these have been dealt with by designers since the first electric pick-ups were built.

The pickup is really a small electric generator which, when the moving system or armature is vibrated by the grooves of the record, generates a small electric current to operate an amplifier system.

ELECTRIC GENERATOR

The generator consists of a magnetic field concentrated across a small gap in which is centred the tongue of the armature.

A small coil of wire surrounds the armature, in which a current is induced when the pickup is in action.

The theory of operation is fairly elementary, but we do not wish to analyse it fully at this stage. It is the familiar story of the lines of force in a magnetic field cutting across turns of wire, and currents being induced to these turns when the field is disturbed, as it is when the armature vibrates. Any textbook on electro-magnetism will contain many pages explaining how this happens, and, as a matter of fact, an article in a future issue might be possible covering it.

ESSENTIAL FEATURES

It is possible to state in general terms the effect on pickup performance of several essential features of this fundamental construction.

The magnet, generally speaking, should be a powerful type, as on the number of lines of force which can be concentrated across the gap largely depends the output of the pickup. Inasmuch as a light pickup is desirable, the magnet should be small, and modern methods of making magnets have allowed a more efficient magnetic system to be developed than could be achieved with old-type pickups with much heavier systems. For the moment this is all we have to say about magnets.

The next, and probably the most important point in the pickup design is the armature and its method of suspension. These two things must be considered together because the necessity for suspending the tongue of the armature in a strong magnetic field requires some method of suspension which, among other things, must be robust enough to keep this tongue central when at rest and prevent it from jumping across in contact with either of the pole pieces which form the gap.

ARMATURE RESONANCE

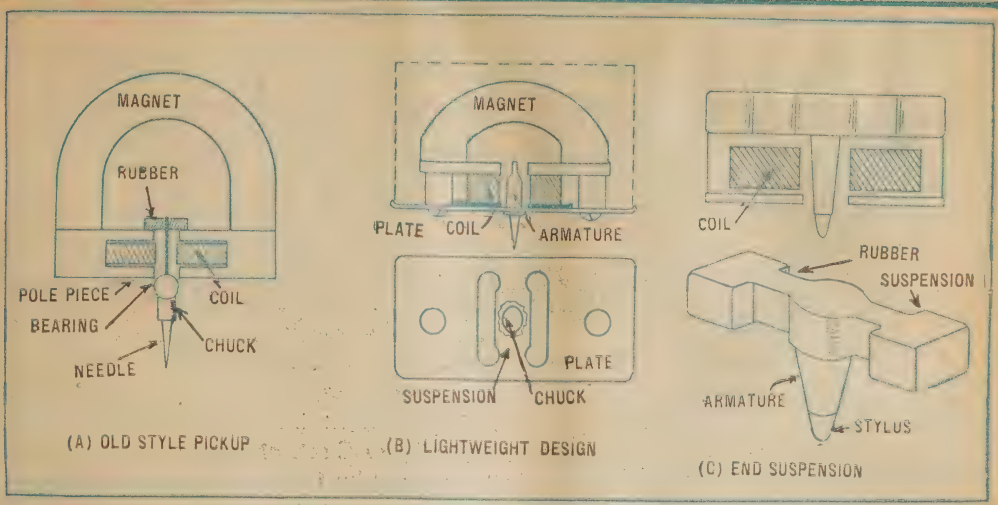
Unfortunately, it is not possible to make such an assembly which will vibrate in exact relationship to the motion imparted to it by the record grooves, because physical laws insist that the armature assembly will have a natural resonance period of its own. If this period represents a frequency which falls within the audible range the vibration of the armature will be much greater at and around this frequency, resulting in much higher output. Thus we have a resonance "peak" about which we have said so much in recent issues.

The two main factors which determine this peak are first of all the mass of the moving system as a whole, and secondly the degree of damping, or resistance to motion provided by the physical suspension of the armature, a quality to which we give the general name of compliance.

MASS AND COMPLIANCE

The lighter we make the armature assembly the higher will be its resonance. The higher we make the compliance the lower will be the resonance. Much of the pickup designer's task is occupied in balancing these two in order to set the reson-

by John Moyle



A.—General construction of an old-type pickup showing massive construction and heavy rubber damping. B.—A popular lightweight design with smaller magnet and greatly reduced armature mass. The plan view shows the suspension plate made of spring steel. C.—A typical end-suspended armature and assembly—the magnet usually mounted at the rear. Some dimensions in all cases have been modified in these drawings for the sake of clarity.

ance as the best frequency. The limitations in both cases are mainly physical, remembering that the final pickup must be robust and capable of being used by all and sundry without damage.

What is the best frequency for this resonance? Obviously, one which is outside the musical frequency range if we desire a pickup which will reproduce all these frequencies at the same strength. As the audible frequency range extends from a few cycles to about 15,000, or 15kc, it is apparent that we should try to fix resonance higher than this figure if our equipment will reproduce the full range, or at least several kc, higher than the highest frequency it will handle, if it does not.

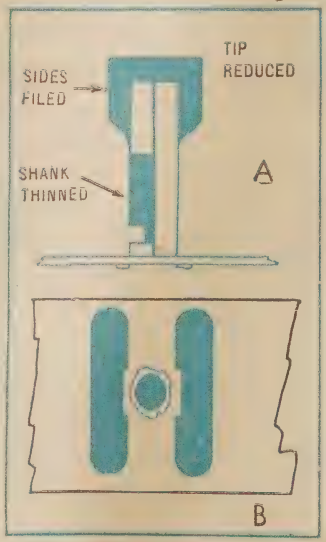
What are the factors which determine the mass of the armature assembly? They include everything which moves when the pickup is in action. We have, of course, the metal shaft of the amature and the tip or tongue suspended in the gap, the needle chuck and screw, if any, to hold the needle, and the needle itself.

The most popular type of armature assembly provides suspension somewhere about the midpoint of its length, the armature shaft and tongue being above the pivot, and the needle and chuck below it. All this constitutes the mass which must move when a record is played.

MECHANICS

No doubt you will recognise the mechanics of this system as an example of a lever pivoted in the centre, and will appreciate also that as the extremities will move over the largest arc, it is important to keep the mass at these extremities low if the natural resonance is to be high. If you are familiar with a musical metronome, you will remember that the further the weight is moved up the arm, the slower it will tick. Therefore, it is also important that the distance from the pivot to the extremities of the armature assembly should be short, if the resonant frequency is to be high.

Summing up, therefore, we want a short, low-mass armature, keeping all the necessary mass as near the pivot as possible. As the needle is part of the armature, we should use low-mass needles and the lightest type of chuck we possibly can. The closer we achieve our object, the higher will be the armature resonance.



A.—Sideview of H.M.V. armature showing metal removed in reducing mass. Great care should be used if the shank is filed in half. B.—Plan of suspension plate showing how metal is filed away to increase compliance and reduce mass.

Coming now to the suspension, we must see that this is as free as possible, which means that the compliance will be high, to avoid undue wear on the record. At the same time the suspension must include some degree of damping to restrict the movement of the armature round its natural frequency, and at frequencies higher than this which might add unwanted oscillations to the pickup output, apart from the point already mentioned of centring the armature tongue in the gap.

Moreover, if we make the suspension too light, we will be cancelling some of our good work in keeping the armature mass low to increase its resonance. In principle, therefore, the best procedure would seem to be to lighten the armature to obtain the highest resonance point, and then increase the compliance as much as possible without bringing the resonance lower than we can afford. If the net result is a robust pickup, we are somewhere near the mark.

HEAD WEIGHT

A point not yet mentioned is the actual weight of the head as applied to the needle point. There is no point in making this any heavier than required to keep the needle point firmly in the record groove even when playing heavily recorded passages. Assuming good point shape, weight required will be governed largely by the degree of compliance. If the needle point can move freely, it obviously requires less weight to hold it down.

Low needle pressure is an advantage in reducing record wear, although the degree of compliance is more important in this respect.

Having reviewed the fundamentals

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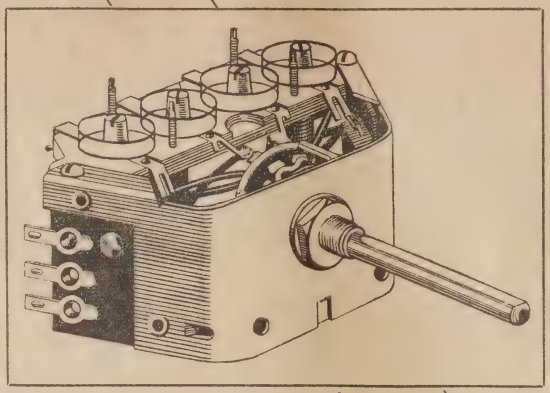

Illustrated approximately life size—the new "Q-Plus" midget Dual Wave Bracket

Retail Price 49/6

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DW5 — ECH35, 33 or — X61M
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NB: This unit now replaces all earlier models.

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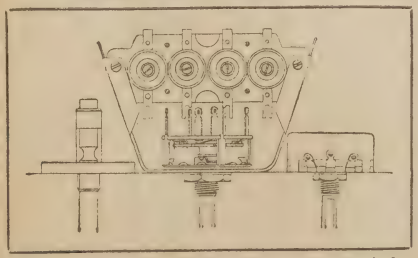

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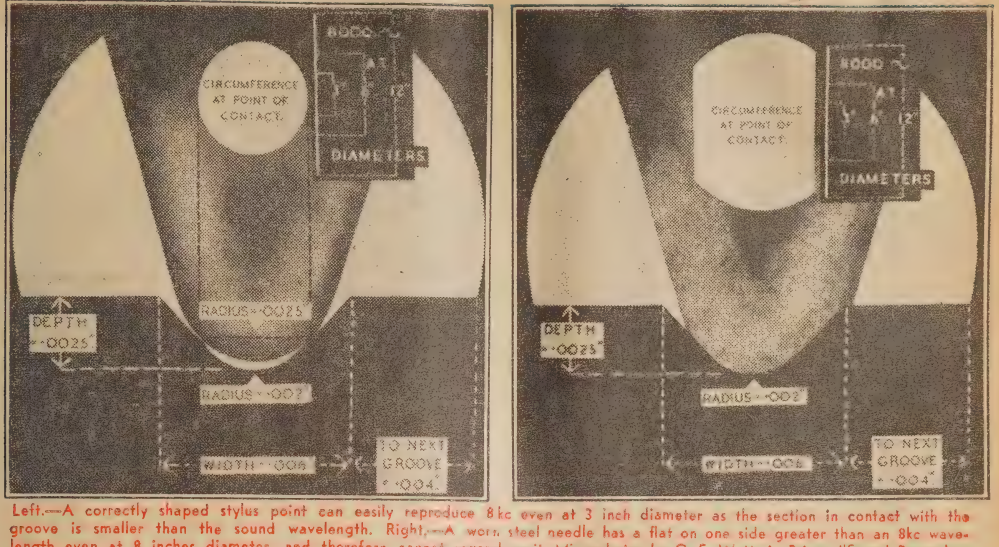
COMPARISON BETWEEN STEEL AND SAPPHIRE STYLUS



Left.—A correctly shaped stylus point can easily reproduce 8 kc even at 3 inch diameter as the section in contact with the groove is smaller than the sound wavelength. Right.—A worn steel needle has a flat on one side greater than an 8kc wavelength even at 8 inches diameter, and therefore cannot reproduce it. Microphotos by C. E. Watts in Briggs "Sound Reproduction". Our tests showed perfect reproduction of 20kc as possible with a well shaped sapphire stylus on the outer groove of 12 inch test record.

of pickup design, let us now examine how these have worked out over the years.

EARLY PICKUPS

The first pickups were real rock crushers by modern standards. The general standard of recordings and equipment were very poor, and pickups were more robust than efficient. The use of heavy, standard needles held into a large chuck with a needle screw ruined any chance of obtaining a high resonance, and the peak frequency was generally about 4.5kc. Heavy damping to keep it within bounds meant a very low compliance, and this, with a weight of up to five ounces, meant severe record wear.

Even today, although some improvements have been made, pickups of this general type are still made and sold, but we have never been able to recommend them, for there is nothing good about them. They are quite unsuited to modern recordings, and used with them will give you little better than a "song and an encore" before the record grooves are irreparably damaged.

Thorn needles will do something to help, but otherwise only make a bad state of affairs worse.

A tremendous all-round advance was made with the advent of the lightweight pickup which made its appearance shortly before the war.

Here the same general construction was used, but highly successful attempts were made to increase compliance and reduce both armature mass and weight. The screw chuck was abandoned in favor of a tiny, lightweight steel needle which was wedged into a small tube which formed the armature, the weight of the pickup being used to make a firm, mechanical linkage.

Instead of the lumps of rubber previously used for damping, and which eventually deteriorated with drastic results, a thin strip of steel was often employed (see diagram) which was actually part of the armature mounting plate. The general construction was compact, and an efficient magnet helped keep the weight down, assisted often by a counterbalanced arm which cut it to about 1½ ounces.

This is the type of pickup we have classed as the medium fidelity type, for its resonance peak occurs between 7.5 and 9.5 kc. Even today this is quite acceptable when used with standard type equipment.

PEAK TOO LOW

Unfortunately, the peak is still too low for wide-range speakers and modern records. It is characteristic of magnetic pickups that there is generally a slight fall in output before resonance is reached, followed by a peak of anything up to 8 db, and finally a sharp cut-off within a few kc of resonance.

If this resonance is removed by a small tuned circuit, and other electrical compensation adopted, response can be made fairly flat over the useful range, but there is no practicable way of extending this range apart from increasing the frequency of the resonance peak.

These pickups are responsible for very little record wear, although the high peak will give a correspondingly high scratch level unless it is removed or avoided.

A number of commercially made pickups of this type use step-up transformers which not only boost their naturally low output, but automatically provide a cut-off before the peak is reached.

This improves their general results, but, of course, restricts the frequency range, often drastically, until some of them are little better in this respect than the older types, although removal of the low peak naturally smoothes out their response.

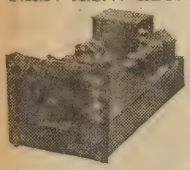
The latest types of lightweight pickups have increased the resonance frequency up to at least 15 kc, and in some cases even higher. This has been done by altering the physical assembly so that the armature, instead of being pivoted in the centre, is suspended from one end, the magnetic circuit and coil being accommodated between the end and the needle tip.

Such construction reduces the total mass quite materially, for it eliminates the necessity for having both a stylus or needle and an armature. In one stroke they have become one and the same thing, a development foreshadowed by some earlier "needle armature" pickups in which the same principle was used.

PERMANENT STYLUS

It is virtually impossible to make such a pickup and preserve the needle changing feature, but actually this is no loss. The lightweight needle wedged into a chuck has many disadvantages which become more apparent as we chase the high frequencies. In any case, it is now virtually replaced by the sapphire-tipped stylus, which must not be

U.H.F. A.S.V. RECEIVERS AR301



Complete with 11 valves: 2— R.F. stages, 5/4 acorns; mixer and oscillator, 2— 955 acorns; 30 mcs. I.F. channel 4 — 6AC7's; detector 6H6; cathode follower 6AC7; rectifier 5V4G. Coaxial switching motor, 24-volt D.C. Frequency range, 160-190 mcs.

Weight unpacked 30lb.

Suitable with minor alterations for conversion to F.M. Band (88-108 mcs.). Television Band (175-200 mcs.), 144 or 288 mcs. amateur bands.

Complete with valves as above in vented metal case, size 7½ x 8½ x 18 inches.

Price, F.O.R. **£8/15/-**

POTENTIOMETERS

0.5 megohm carbon	1/6
25,000 ohm carbon	1/-
5,000 ohm 25w, I.R.C.	4/6
500 ohm midget carbon	1/6
250 ohm 25w, I.R.C.	4/6
6 ohm wire wound	2/-

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0-3.5 mA. D.C. 2½ inch round flush	17/6
0-10 mA. D.C. 2½ inch round flush	7/6
0-30 mA. D.C. 3 inch round flush	25/-
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0-30 volt D.C. 3 inch round flush with datum indicator	30/-
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Contains 4 position crystal socket; 4 ceramic insulated midget variable condensers 75 mfd. with 1½ x ¼ inch shaft; 3-9 mcs. coil and 4 position switch. Complete in metal case 5 x 4 x 2½ inches.

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TR1133 Genemotors, 12v. input, output D.C., 300v. 240 mA., 150v. 10 mA., 6v. 5A., filtered each £4/10/-

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Gibson Girl emergency Transmitters £7/10/-

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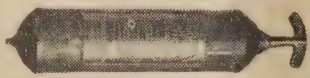

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275v. C.T. 275v. 40 mA. 6.3v. 3 amp.	13/6
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150 mA.	20/-
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3Q5GT	10/-	954	12/6
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6H6GT	7/6	12A6	10/-
6SH7	8/6	12SG7	10/-
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6F6	15/-	7F7	11/6
6H6	10/-	7N7	11/6
6J5G	11/-	83V	11/-
6J7G	12/6	828	35/-
6K8G	12/6	832	70/-
6SG7	12/6	879/2 x 2	15/-
6SJ7	15/-	1293	11/6
6SK7	15/-	1294	11/6
6SQ7	12/6	VR54/EB34	5/-
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Colour: Blue. Length, 5½ inches. Ideal R.F. Indicators.

Price, each **2/6**

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Freq. range 190-550 Kcs. 85 Kcs. I.F. channel. Valve line up: 12SK7, 12K8, 12SK7, 12SK7, 12SR7, 12A6. One R.F. Stage, two I.F. Stages. Ideal for conversion to car radioes or selective double conversion sets. Size: 4½ x 5½ x 16½ inches. Weight 6lb.

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Also available 3-6 mcs. and 6.9 mcs. ranges complete with valves. NEW **£6/10/-**

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Please add exchange to all cheques. Make money orders and postal notes payable at Lewisham. Sorry, No C.O.D.

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removed once fitted. Cheaper production methods now makes it possible either to discard the armature assembly when the point is worn out, or even to discard the whole head, which may be replaced at little more cost than that of a stylus itself.

Despite the high resonance, the compliance of these pickups is very high, and as a result less than one ounce is generally required to keep them tracking on the record. They are possibly a little more fragile than the earlier lightweights, although quite equal to any amount of wear under normal conditions. It is care with the sapphire tip which is most necessary. Dropping the pickup on a record might easily chip the point and render replacement essential.

OUTPUT

The output from these pickups is generally about 40 millivolts — a little lower than many predecessors. This is possibly because the movement of the armature where it passes through the coil and pole tips is obviously not as great as with the older type of centre-suspension, where the coil and tips are mounted at the extreme tip of the armature.

While all these new pickups will sound quite well played without compensation, the presence of any undamped peak will have its effect on the wave-form of related frequencies lower in the range. Therefore it is a good idea either to remove the peak by compensation, or to use a low-pass filter to restrict the range below the peak frequency. As a rule, this will result in a much cleaner wave-form.

Apart from the presence of the resonance peak, there are other things which can cause poor wave-form, many of which are not easy to trace. One of these is the presence in the gap of too large a mass of iron, which in some ways is the same as having too small a gap between the pole pieces.

For a clean wave-form, the armature should move in a perfectly uniform magnetic field.

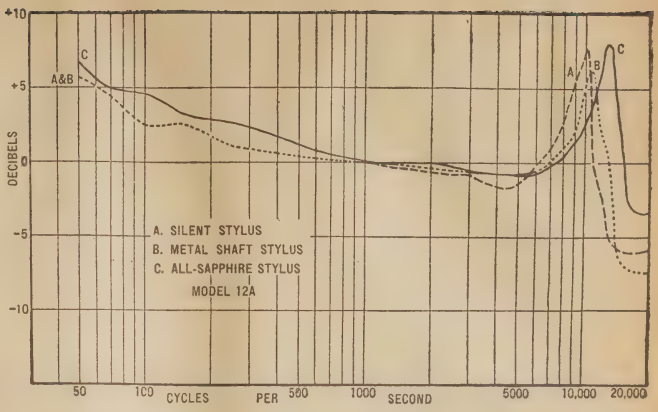
Being suspended at one point, it cannot approach and recede from the pole pieces with its axis at all times at right angles to the lines of force. Too small a gap, or too large a mass in a given gap, accentuates this lack of linearity, and results in poor wave-form.

HARMONIC DISTORTION

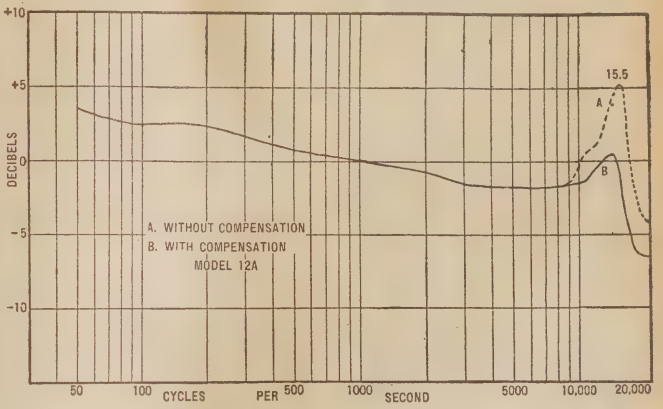
This limitation on mass and gap clearance also limits output, for small gaps and large mass will considerably increase output. Once again, the designer has to work close to the wind, and balance one against the other.

Opinions differ as to the importance of some harmonic distortion above about 6 kc, remembering that the second harmonic of 6kc is 12kc, and the third 18kc. If these frequencies are not reproduced, and often they are not, does it matter if they are there?

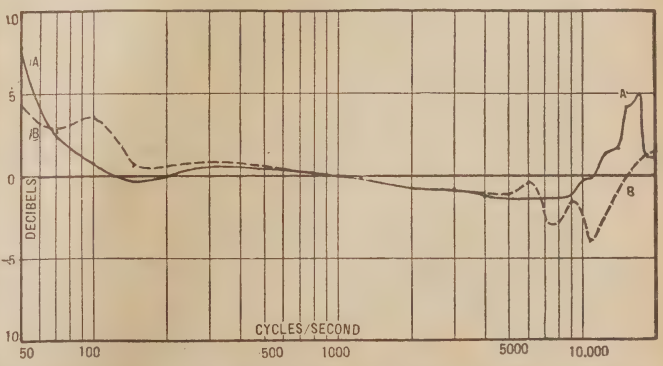
Personally, I think it does, particularly on a wide-range equipment. As I shall later show, failure to reduce resonance and to suppress unwanted



This graph shows the original 12A frequency curve with (a) silent stylus, (b) metal shank sapphire stylus and (c) all sapphire stylus. Resonance peaks with this plate are a little higher than the average.



Here is the frequency curve of the 12A treated as detailed in this article. Dotted section shows peak suppression by the trap circuit also detailed here. Waveform is excellent.



Curves of the two widest range pickups so far tested by us. Curve A has fair waveform, but not as good as the revamped 12A. Curve B has rather poor wave-form. Both are greatly improved by the use of the trap circuit.

frequencies in the upper region which may result from random excitation of the stylus, show up quite clearly on the oscilloscope, and cause intermodulation of frequencies themselves within the audible range.

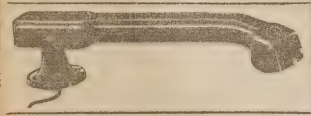
I believe that the absence of these unwanted frequencies contributes ap-

GOLDRING QUALITY PRODUCTS

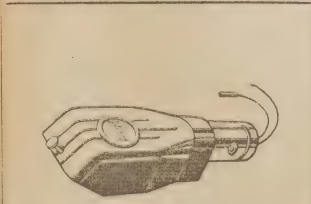
PICKUP RANGE

Type	Output	Frequency Range	Stylus	Particulars	Price
HEADMASTER					£ s d
Supplied with: 1 Cartridgarm 12". 3 Cartridges. Tonaliser C. Multiple transformer.	45 millivolt 250 millivolt with transformer.	30-18000	Sapphire	Highest quality reproduction of all records. Interchangeable cartridges with sapphire points of correct dimensions. Easy & quick operation of plug-in cartridge. Recognised by experts as the best & cheapest Pickup on the market.	
				COMPLETE	10/14/6
				Cartridge arm	1/8/6
				Each cartridge	1/8/6
				Tonaliser	2/16/-
				Transformer	2/6/9
				Cartridge Arm (16")	1/19/6

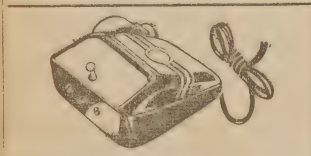
LIGHTWEIGHT PICKUPS					
121	.25 Volt	30-8000	Replaceable Sapphire	High Output.. Medium frequency range. Ideal for use with standard receivers. Low needle pressure minimising record wear.	3/13/10
122	.25 Volt	30-8000	Replaceable Sapphire	As above. but finished in florentine bronze.	3/13/10
123 (MAGNA)	.25 Volt	30-8000	Replaceable Sapphire	As above, but with one Interchangeable Cartridge. Ideal for Commercial or P.A. equipment with quick needle changing or replacement essential.	3/13/10
125	.25 Volt	30-7000	Standard Needles	The Lightweight P.U. using standard size Sapphire, steel, or thorn needles.	2/17/-



BANTAM PICKUPS					
130 130/IVORY	.3 Volt	40-7000	Standard Needles	Inexpensive, sturdy, reliable. Really good value.	2/1/2 2/5/6



REPLACEMENT HEADS					
G.1	.25 Volt	30-8000	Replaceable Sapphire	Owners of Garrard Changers from R.C.4 to R.C.70, can easily and without skill IMPROVE their reproduction and preserve their records by using this Lightweight Head. Low needle pressure and all other advantages of Lightweight Pickups.	2/15/9
G.2	.25 Volt	30-7000	Standard Needles	As above, but using standard size Sapphire, steel or thorn Needles. Low needle pressure and most advantages of Lightweight Pickups.	2/5/3



PICKUP HEADS					
112	.3 Volt	45-5000	Standard Needles	Convert your Portable Gramophone into a Record Player simply by connecting the Pickup Head to the Wireless set.	1/13/4
112/Ivory	.3 Volt	45-5000	Standard Needles	As above, ivory finish.	1/15/1

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preciably to clean reproduction, and has a greater effect on needle-scratch than is often appreciated.

Once again, I am speaking of high-fidelity reproduction, and all the remarks which now follow are made with the idea of achieving as near perfection as the state of the art at present will allow.

PRACTICAL WORK

There are many other aspects of pickup design which I cannot cover here, and quite a few about which I do not feel competent to speak. However, I have sketched enough of the fundamentals for you to appreciate the experimental details which follow, in which these fundamentals were demonstrated by actual practice.

In order to ascertain just how variations in design affect pickup performance, a standard, medium-fidelity pickup was selected, and subjected to many constructional indignities in the cause of science. Some of these were suggested by readers who had also felt the urge to do the same, but most originated in the more fiendish section of our own imagination.

The pickup selected was the HMV Model 12A, which is similar in construction to other HMV models, and a number of pickups made by other firms. The 12A is a beautifully-made job — probably the best of them all mechanically — and capable of being dismantled and assembled easily and quickly.

It was originally designed for good quality and hard work, and it has proved a grand standby for people such as broadcast engineers all over the world. In other words, we selected it not because it is a poor pickup, but because it is about the best in its field. The fact that we were able to achieve such fine results when we had finished with it is a tribute to the soundness of the original design.

The diagram shows the construction of the armature plate assembly, which is easily taken from the head by taking off the cover and removing two screws.

The general procedure was to check a number of armature plates—easily obtainable, incidentally, for about five shillings—first in their original condition, then with various types of stylii, and finally after alteration to the armature mass and to the compliance.

BASIS FOR EXPERIMENT

More than one hundred curves were run off, and over a dozen plates treated before arriving at our results. The figures given here are representative, although some plates were found to start with up to 2kc higher resonance than others.

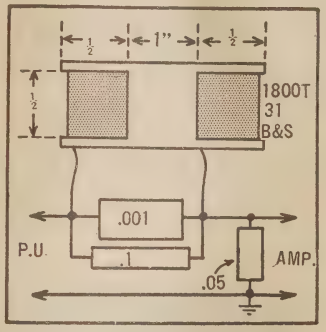
Incidentally, our results might provide an interesting basis for experiment for the thousands of readers who will have pickups of this type. The ease with which the pickups can be handled and restored to their original condition means that you run virtually no risk of damaging them.

The frequency record used for these tests was HMV DB1189.

A typical pickup in its original form showed a resonance of 8.5kc with a silent stylus needle, 10kc with a miniature lightweight sapphire stylus, and 12.5kc with the all-sapphire rod stylus. These results demonstrated immediately the importance of armature mass in setting resonance, for the rod sapphire is much lighter than the other two, and improved matters by several kc over any other type.

The wave-form of the silent stylus was much inferior to the other two, the rod sapphire being easily the best. This is probably due to its superior groove fit, and its thicker body sitting more firmly in the needle-chuck. This superiority of wave-form and lighter mass made us select it for all subsequent tests.

The next step was to lighten the armature still further, and the most effective spot for removal of metal was, naturally, from the tip of the "tongue." This was carefully filed down to about half its original height with a small jeweller's file, used for all this work.



Details of peak suppressing trap circuit connected in the hot lead of a high impedence type lightweight pickup working into a load resistance of 50,000 ohms.

The resonance now rose to 14.5kc, and the wave-form, which previously showed definite signs of distortion at related frequencies, was greatly improved, indicating that the original size was right on the danger-line in this respect.

The next step was to split the stylus tip to half its thickness and narrow the width to that of the shaft. This was easy, because the shaft is of split tubing flattened to form the tongue. Filing from the split side soon cut away the unwanted metal in two small pieces. Great care was taken to avoid damaging the top end of the tube, which serves as the socket for the stylus end.

The resonance now shot up to 17kc and the output fell by about 30 per cent, which was only natural with so much of the metal cut away.

Having reduced the mass, the next step was to increase the compliance. This was done by filing the supporting strip of metal until it was the same width as the narrowed section right down to the needle-chuck, taking great care not to cut too near the chuck itself, which

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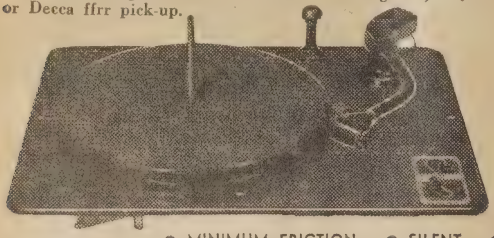

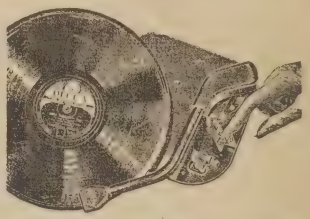

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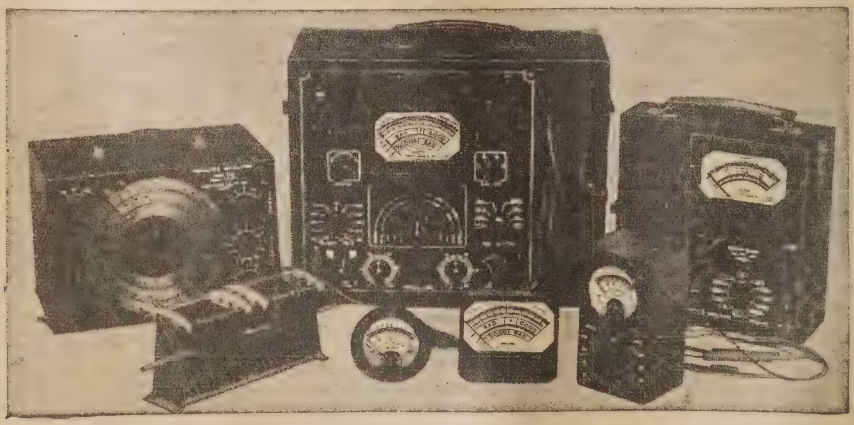

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would have weakened the strip at this point.

This increased compliance brought the resonance down again to about 15.5kc.

As a final shot, the rod sapphire was ground down to about two-thirds of its original length. This increased the output almost to the original value and slightly increased the resonance frequency.

The wave-form of the final assembly was now better than that obtained from any other pickup we have tested, and was quite free from any distortion, apart from slight sharpening of the sine wave at some points and slight flattening at others, according to the type of harmonic involved.

20KC PEAK

As already mentioned, some plates gave figures higher and lower than these, and some were subject to further treatment. By filing away the armature tube from the front until it was merely a thin half-tube supporting the socket at the top, thinning the metal which remained, and removing all excess solder, &c., resonance on one plate was pushed up to over 20kc, the limit of the frequency record used. The final job was rather fragile, however, and our standard treatment suggested above is probably the best compromise between output, resonance, peak position, and strength.

In fact, there appears to be a definite relationship between mass, compliance and stylus length which, if not observed, spoiled results, particularly in the matter of distortion. If the more drastic treatment is given, it is almost essential to have an oscilloscope to observe waveform to obtain the optimum figure.

Finally, counter-weighting the arm by the addition of six washers made from sheet lead and slipped over the threaded rod supporting the present counter-weights was adopted, thus reducing effective weight on the stylus tip without spoiling the wave-form.

STYLUS FIT

A few further remarks might be in order. It was found that a firm fit in the armature chuck was essential to avoid waveform distortion and erratic results. The superiority of the rod stylus was maintained throughout the tests, and we finally fixed it in place with a light application of Tarzan's Grip. You can forget the idea of using steel needles. Not only are they much too fine in the point, but they will not fit firmly enough into the chuck to retain firm contact at all times.

It is essential to retain the rubber damping square which fits under the plate. Without it, the armature plate will be shock-excited at random frequencies and quickly ruin records through the high-point stresses which are set up. At a penny a time you can afford to renew this rubber as often as may be necessary.

See that the stylus tip is always central in the gap.

The original pickup is fitted with a 10 ohm coil which produces a

(Continued on Page 92).

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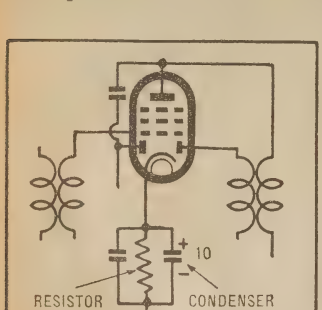
FROM THE SERVICEMAN WHO TELLS

In servicing receivers, a little extra care often pays dividends in avoiding frequent repeat calls. These often yield a quick return but earn one a bad name in the long run. The worst possible advertisement is a client who says "you only had it a month ago . . . . "

I HAVE good reason to say all this, of course, the said reason being a typical little 4-valve mantel job. The owner dropped it into the shop and left me in no doubt that it was the only set he had in the house, that his wife's whole existence depended on it, that there couldn't be much wrong with it. In short, he wanted it back "quick smart."



A faulty resistor was nearly overlooked because the electrolytic continued to pass current.

The trouble, by the way, was that it had to be turned full on to receive the stations and, even then, they weren't very loud.

Instead of following my natural inclination to be difficult, I plugged the set in as soon as his back was turned and verified that there was indeed just cause for complaint. One peep into the back of the cabinet showed why.

The 5Y3-G rectifier was adorned by a violet glow which filled most of the top of the glass dome and extended down around the electrode structure. The envelope obviously contained a goodly proportion of gas, and ion bombardment of the filament had just about wrecked its emission. I have referred to this more than once in these columns.

NEW RECTIFIER

Plugging a new 5Y3-GT into the socket brought the signals to their accustomed level and made it necessary to turn the volume control back to about half-on. I might have been excused for pushing the set aside at this juncture, writing a docket for a new valve, and leaving the matter rest there.

However, being a careful kind of fellow (such modesty!) I tuned the set across the band, and was not altogether satisfied that it had the volume and "punch" that it should. Some deterioration is natural as a set ages, because all the valves get weaker and alignment drifts slightly. Whether it is always worthwhile to correct these failings is a matter of debate.

In this case the margin seemed a little too high, and I decided, rather grudgingly, to take the chassis out of the cabinet. Then folowed the usual operation of tightening the dial lamps, brushing away years of accumulated dust, oiling the controls, and so on.

After that, a check on the operation showed that the converter and IF screen voltage was unusually high, likewise the bias on the IF amplifier tube—a 6G8-G, with the diodes serving also for detection and AVC. All the components appeared to be in place and I could see no obvious explanation for the unusual operating voltages.

CATHODE CIRCUIT

A potential on the AVC line can upset calculations, of course, but shorting the line in this set made no difference to the voltages. There had to be something wrong with the cathode circuit. And there was!

The 300 ohm cathode resistor was bypassed by two condensers, a 0.1 mfd paper and a 10 mfd electrolytic. The paper condenser was all right, but a check on the electrolytic showed a much lower resistance than normal. Any electrolytic will show some resistance, of course, even when the test prods are round the right way, but this one was down to a few hundred ohms either way, the value gradually changing as I watched the meter.

Next step was to check the 300 ohms resistor and, sure enough, it was wide open. Apparently, in service, the low voltage electrolytic was passing enough cathode current to keep the set in operation, although producing more bias than desirable for optimum results. Hence the reduced sensitivity.

HIGH SCREEN VOLTS

It is certainly not usual to operate sets that way, so I duly replaced both the resistor and the much overworked electrolytic.

Then another curiosity. A check on the screen volts showed that they were still too high on both the converter and the IF amplifier, a common dropping resistor being used. The bias was now right, there were no unwanted volts on the AVC line, plate volts were right, and the valves tested "Good." Finally, a check against screen characteristics showed that the resistor value was accurate by both calculation and measurement. How come?

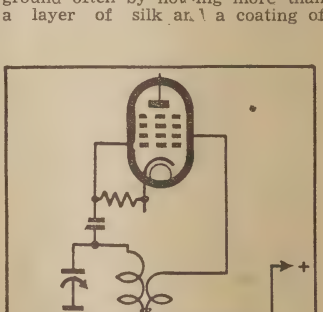
Still wondering, I plugged in a new converter and the screen volts landed dead on 100, with no station tuned in. Obviously the original converter, by some structural characteristic, was drawing a lot less than the rated screen current. The main worry was whether the extra volts on the IF valve would cause trouble.

I reckoned that it would not, seeing that the valve would be biased back most times by the AVC action. The likelihood of the screen dissipation being exceeded was rather slight. I therefore did not replace the converter valve nor increase the screen resistor. The chances were that the set had operated that way from birth, anyway!

But it goes to show how too much haste can leave room for troubles at a future date.

POOR INSULATION

I have often looked with misgivings at the way primary windings carrying HT are insulated from the secondaries. Short-wave RF coils are the classic example, the high tension often being separated from ground often by nothing more than a layer of silk and a coating of enamel. It's a wonder that half the dual-wave sets in creation haven't come to a full stop with a shorted HT line.



A short between windings in the oscillator coil made operation uncertain but caused no damage otherwise.

Of course, having said as much, I have given away the answer to the next problem before actually stating it.

The set was intermitent in its behavior, in that it could not be relied upon to receive all the stations.

2FC was there most times, though its position on the dial was uncertain, but the other stations came and went seemingly without reason.

When this much was explained, there was no difficulty in deducing that the trouble was in the oscillator section of the set and, just for once, it was misbehaving itself when I arrived on the scene.

Running the multimeter over the oscillator section revealed that there was a positive voltage on one side of the padder and also on one section of the tuning gang.

It was hardly likely that this would be intended in the original design, since dust between the plates of a highly-charged condenser is a prolific source of noise.

Further investigation revealed that there was a short between the two windings of the oscillator coil, but I had to remove the can to find it. As you already might have guessed, I found that one lead of the feedback winding was hard against the secondary and a short had developed through the insulation. No harm had been done to the coil or to other components and it was simply a matter of lifting the offending wire away and making sure that it would not short again.

UNUSUAL COVERAGE

Some clients make very unusual requests. One recently asked whether I would remove the existing short-wave coils, which tuned only from 13-42 metres and put in a set of coils which would cover the entire band from 10 to 100 metres. He reasoned that everything would then be audible on the short-waves and he didn't mind in the least paying for the two new coils.

Unfortunately, I had to take several minutes off to explain the fallacies in the scheme, otherwise he would merely have thought I wasn't equal to the task. Well, perhaps I wasn't.

Becoming slighly mathematical, it is necessary to remember that the resonant frequency of a tuned circuit is inversely proportional to the square root of the tuning capacitance. Breaking this down into words of fewer syllables, it means that, to effect a 2-to-1 change in frequency, it is necessary to have a 4-to-1 change in capitance.

Now a standard tuning condenser has a tuning range of from 9 odd pf to something over 400, a ratio of better than 40-to-1. However, by the time the paralleled capacitance of the trimmer, the switch, wiring, the coil and the valve is added to both totals, the ratio of maximum to minimum dwindles to little more than 10-to-one. Therefore, the tuning range is limited to just over 3-to-1.

TUNING RATIO

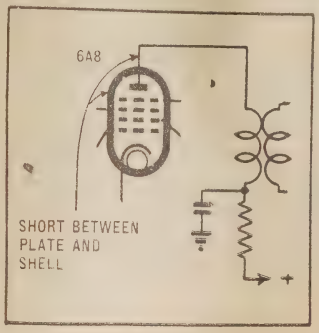
You will find this ratio in the tuning range of any broadcast receiver and on the conventional short-wave bands, 13-42 metres, 16-50 metres, and so on.

However, even if by some cajolery you were able to obtain a tuning gang with a larger maximum capacitance, its usefulness would be very limited. At the low frequency end of the band the ratio of inductance to capacitance would be low and the performance of the tuned circuit extremely poor as a result.

Then again, assuming that you could get over this hurdle, the set would be almost impossible to tune. At the moment, with only a 3-to-1 coverage, the short-wave stations occupy only a hair's breadth on the dial and the smallest amount of backlash is troublesome. Push the tuning ratio up to 10-to-1 and you would either have to use an engineering masterpiece as a dial, or develop the patience of a Job.

In other words, I told our friend, there is only one way to obtain wider coverage and that is to add another bank of coils and trimmers and install a 3-position wave-change switch. The lack of calibrations for the new band is just another problem.

I did NOT tender for the job!



An unsuspected valve short made this look first like a broken-down condenser, then a fault in the I.F. transformer.

A big 8-valve push-pull job stopped suddenly in the middle of an interesting programme and not all the anguished pleadings and manipulations of the owner would make it go again. It was still stubbornly silent when I arrived on the scene.

All the valves were alight, but the radio and pickup channel were completely dead, apart from a slight hum which indicated the presence of high tension on the output valves at least. There was nothing for it but to wheedle the rather large chassis from its cabinet.

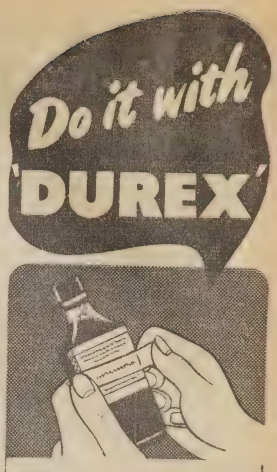
A check showed about 200 volts on the plates of the output valves but only about 25 on the screens. The same 25 volts could be measured anywhere else on the high tension line. Strange but true!

STRANGE SHORT

An inspection of the circuit revealed that the plates of the output valves were fed from a point early in the filter system, with the screens and the rest of the H.T. circuit fed through a large series dropping resistor. This was very hot, indicating an apparent partial short on the remote end.

Switching the set off, revealed only a few hundred ohms of resistance between this point and chassis, so I had

(Continued on Page 95)



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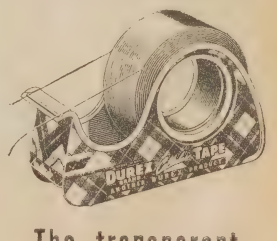

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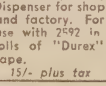

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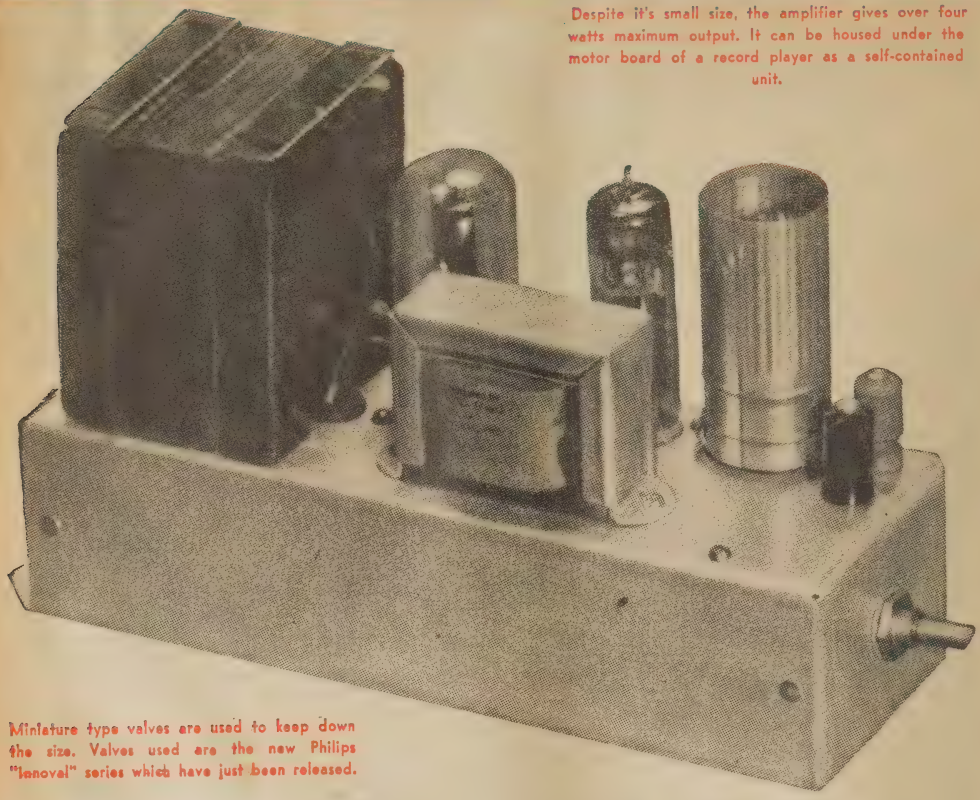


Despite it's small size, the amplifier gives over four watts maximum output. It can be housed under the motor board of a record player as a self-contained unit.

Miniature type valves are used to keep down the size. Valves used are the new Philips "Ienoval" series which have just been released.

A BABY 4-WATT AMPLIFIER

With plenty of gain for a lightweight pickup, this baby amplifier can be stowed away in a minimum of space. For all that, it delivers a full four watts of output and has plenty of punch for the average home. The circuit features two new miniature Australian valves.

A BABY amplifier has an attraction all its own, particularly if it can turn on a performance out of all proportion to its physical size. Looking back over past years, one of our most popular circuit innovations was a one-valve amplifier, which used a crystal pickup to drive a single 6V6 output valve. For sheer simplicity and the ability to play records without fuss and bother, the little amplifier was a revelation.

While the scheme is still perfectly practicable — and there are still plenty of one valve amplifiers in use —the pickup position has changed considerably in the meantime. Pickups have been introduced having lower mass and higher needle compliance and therefore imposing less wear on the records. At the same time, resonance peaks have been shifted upwards, response curves smoothed out and distortion levels lowered. What, then, are the chances of using such pickups with a baby amplifier?

PICKUPS

If the term is to be restricted to mean a single output stage, the chances are indeed slight. It follows, almost as a matter of course, that mechanical improvements in pickup design result in reduced electrical output, so that the modern lightweight magnetics have only a fraction the output of their earlier counterparts.

While the position is assisted somewhat by the provision of step-up transformers, the principle cannot be carried too far because inexpensive high ratio transformers almost invariably show a severe loss in the upper treble range.

A further point is that magnetic lightweights all need bass compensation in the amplifier to correct the recording characteristic and there is no reserve of gain to provide for this in a single-stage amplifier. Two amplifying valves must obviously be used, in addition to the rectifier, and the problem becomes one of achieving the desired characteristics in the simplest and most compact manner.

Quite logically, therefore, we have suggested the use of miniature valves which are appearing on the local market in increasing numbers. However, if you have other ideas, or other components on hand, the circuit can be applied equally well to full-sized valves. It will simply be a matter of enlarging the chassis dimensions by an inch or so either way.

In the interests of gain, the first valve is a pentode and we have selected the new Australian-made 6N8, which is now readily available. It has a standard RMA nine-pin "noval" base and your supplier should not have any special difficulty in obtaining sockets to suit.

The 6N8 is a twin-diode general-purpose pentode, which may be regarded substantially as a miniature version of the valves like the EBF-35 and 6AR7-GT. By choice of suitable operating conditions, the pentode section may be used equally well as an audio, RF, or IF amplifier. In audio service, the gain is approximately 150 times, which is typical for a pentode of this general class.

OPERATING CONDITIONS

The suggested operating conditions differ slightly from the manufacturer's specifications but the components are more easily obtained. They should work out well enough also for other miniature pentodes or for larger valves like the 6SJ7-GT. As we mentioned earlier, there is no reason at all why this circuit should not be used with larger valves, if you happen to have them on hand.

The output valve is another miniature in the same noval-based series. It is a high-slope output pentode with electrical characteristics similar to those of the larger EL3 and KT61. The full power output of four watts is delivered with a signal input of just under 4 volts RMS.

In common with other high-slope valves, the 6M5 needs careful handling to avoid trouble with parasitic oscillation. Grid and screen suppressors should be fitted as a matter of course, and these are shown in the circuit. Mount the sockets in the way which will avoid long leads and, in particular, keep the plate lead away from the grid or input wiring. The screen and grid suppressors should be mounted close to the socket.

SMALL CHASSIS

As will be obvious from the photographs, the amplifier is quite small in size. The chassis measures 8" x 2¾" x 2" deep, with a flange at the transformer end to allow it to bolt into a cabinet. The weight at the other end is so slight that the chassis can well be held in place by the control spindle which will pass out through the panel. We had in mind that the amplifier would generally be mounted in a small cabinet, together with motor and pickup.

Even with these modest dimensions, there is plenty of room on top of the chassis and the components could have been pushed closer together to save an inch or so. However, there seemed to be no point in crowding the layout so much that wiring would be difficult.

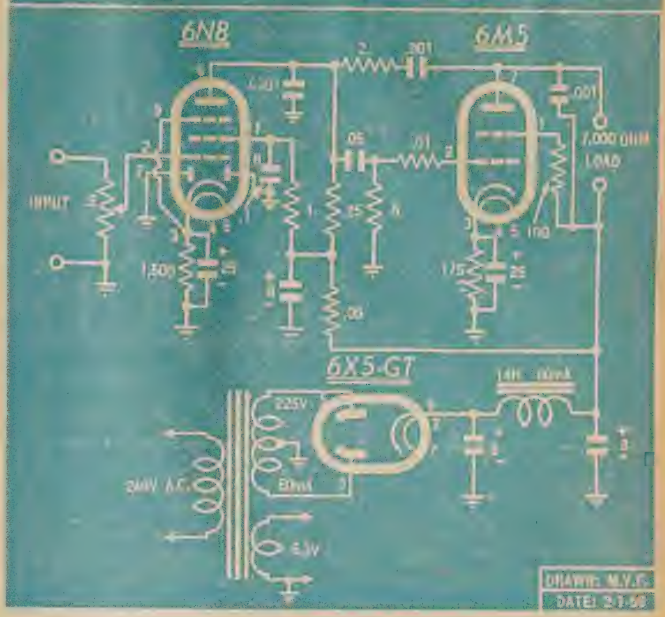
The same circuit exactly can be used for valves like the EL3 and KT61, but lower gain types will need a larger bias resistor. Thus the American miniature type 6AQ5 and the larger 6V6-GT will need a 300 ohm cathode resistor to maintain the same general voltage and current conditions. The gain with these latter types will be somewhat lower and the bass boost slightly reduced, so that they are not the best choice for pickups in the lowest output group.

In the power supply we have used the standard 6X5-GT rectifier, mainly because the miniature rectifiers are not yet in very good supply. A rectifier is planned for the noval-based series, but the only miniature on the market at the moment is the 6X4 on a 7-pin button base. This is electrically similar to the 6X5-GT.

The power transformer is the new small 50-milliamp type made available originally for the R&H "Cornerset," but obviously a very useful component for all small sets and amplifiers. Allowing for the drop across the filter choke, the transformer provides just under 250 volts of filtered d-c. This is a trifle on the low side, but we were able to measure a full four watts of output across a resistive load in the plate circuit.

To provide this output, the 6M5 requires approximately four volts RMS of input signal. Since the gain

CIRCUIT OF THE AMPLIFIER



Here is the circuit of the amplifier. Adequate suppression is included to guard against instability — always likely when high gain valves are used.

PARTS LIST

1 Chassis 8" x 2¾" x 2".
1 Power transformer 225V/225V 50mA., 6.3V 2A.
1 Filter choke 14H. 60 mA.
1 Octal valve socket.
2 Miniature nine pin valve sockets.
1 Miniature four pin speaker plug and socket.
2 Terminals (1 red, 1 black).
1 Knob.

VALVES.
1 6N8, 1 6M5, 1 6X5-GT.

RESISTORS.
1 2 megohm, 1 1 megohm, 1 .5 megohm. 1 .5 megohm potentiometer, 1 .25 megohm, 1 .05 megohm, 1 1,500 ohm, 1 175 ohm 3 watt W.W., 1 100 ohm.

CONDENSERS.
2 25 mfd 40 Pv electrolytics, 3 8 mfd 525 Pv electrolytics, 1 .1 mfd 400 V tubular, 1 .05 mfd 400 V tubular, 2 .001 mfd mica, 1 .0001 mfd mica.

SUNDRIES.
Resistor mounting strips (1 3 lug and 1 5 lug), solder, solder lugs, nuts and bolts, hookup wire, power cord, material for valve shield etc.

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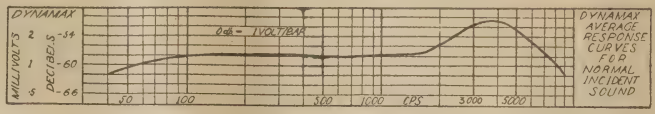

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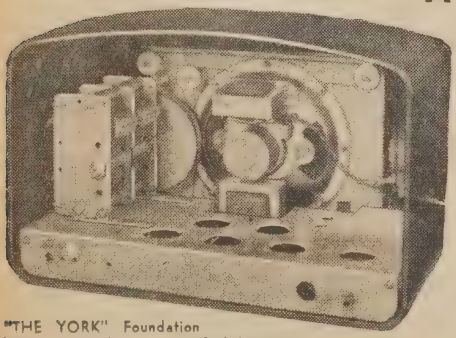

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of the first stage is about 150 times, the input signal required would normally be about 26 millivolts. This is a good deal lower than necessary, which is fortunate, since some of the reserve gain is required to provide for negative feedback and bass boost.

Reviewing the pickups available and compensation requirements, we reckoned that something over 12db of feedback would be about right. The 2.0 meg feedback resistor shown provides an actual 15db, which is equivalent to a gain reduction of 5½ times. The input for full output therefore rises to 150 millivolts.

This figure will be exceeded easily on peaks by pickups having a nominal 100 millivolts output at 1000 c/s. It means also that pickups in the 40-milliwatt class will drive the amplifier enough for domestic listening without recourse to a step-up transformer.

BASS BOOST

Bass boost has been achieved in the only possible way, by modifying the feedback at the low frequency end. The .001 mfd condenser in series with the feedback resistor lifts the bass below 250 c/s and produces a curve which lies very close to the ideal down to about 70 c/s.

What happens below that is largely a function of the output transformer. With ordinary types, the response will flatten off in this region and then droop downwards again as the limited inductance takes charge of things.

A special output transformer will do a lot better than this, of course, but we have not stressed the point, seeing that the amplifier is intended especially to be compact and not too expensive.

If you want more boost with a further reduction in gain, the 2.0 meg resistor can be dropped to 1.5 meg. As before, the exact shape of the curve will be modified by the characteristics of the output transformer and, in the ultimate, by the arm resonance of the pickup you finally select. Most of the pickups show a rise of several db around the 50-cycle mark.

WITH RADIO

When using the amplifier with a radio tuner, or an externally compensated crystal pickup, no bass boost will be required. To eliminate the bass boost, simply short out or eliminate the .001 mfd condenser in the feedback network. A switch can be installed for the purpose or the condenser shunted with a 1.0 meg potentiometer to give a variable bass control. Please yourself on this score.

No treble control has been provided, again in the interests of simplicity. If you want one, however, wire a 0.5 meg potentiometer in place of the 6M5 grid resistor. Then connect about a .005 mfd condenser between the moving arm and earth, and you have your treble-cut control.

Too much crowding could also lead to instability trouble, especially for inexperienced constructors. As it was, we found that there was a tendency to capacitive coupling between the two miniature valves unless they were separated by at least an upright metal plate, despite the fact that the valves have internal shields. Since the point was not appreciated until after construction was finished, we found it easier to solder a tinplate valve shield, intended for "GT" valves, to lugs under the socket mounting screws. The construction otherwise is perfectly straightforward and need cause no worry.

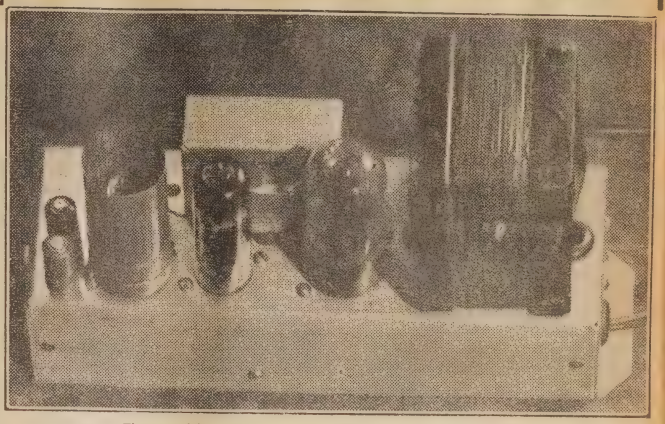
The input terminals will be seen at one end of the chassis and handy to the volume control immediately underneath. The leads are so short that there is no opportunity or need to use shielded wire anywhere in the amplifier.

The cathode and screen components can be placed close to the 6N8 socket but, for the sake of rigidity, the feedback components and the plate bypass were located on a terminal panel which will be seen attached to the side of the chassis.

Other components around the 6M5 can be tucked in between the sockets or mounted to one side.

There is plenty of room under the power transformer for the main filter condenser and the decoupling components for the 6N8.

SIDE VIEW OF THE AMPLIFIER



The amplifier inside view. The rectifier is a 6X5-GT.

Connection to the speaker is via a miniature 4-pin socket, the appropriate plug being attached to the speaker leads. The .001 mfd bypass shown between the output plate and B-plus can very conveniently be connected across the speaker socket.

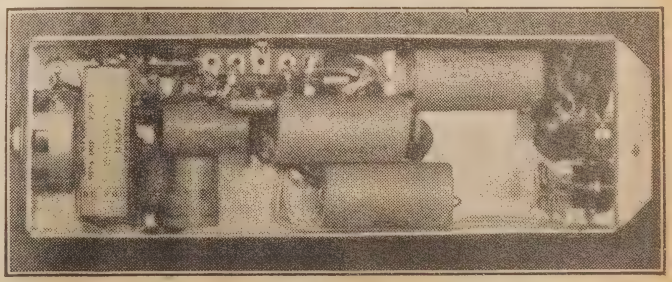
POWER LEADS

Use a small terminal strip to anchor the 240 volt leads from the power transformer and either cover the lugs with adhesive tape or place them so that they cannot be touched by straying fingers while the chassis is being handled.

Apart from the deliberate rise at the bass end, the overall response of the amplifier is substantially flat to at least 15kc and the distortion level is inherently low. There is no reason, therefore, why the amplifier should be any different from a larger job within its power ratings and the limitations of the output transformer.

Over and above that, the volume and quality of sound will depend largely on the loudspeaker and its baffling arrangements. It is wise to avoid anything smaller than a 7" speaker and, generally speaking, the larger and more expensive the speaker, the better will be the results.

A 12" speaker in a vented en-



Showing placement of components under the chassis.

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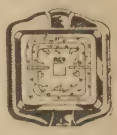

This portable D/W Kit Dial has all parts supplied ready to assemble and has a glass scale with B/C and S/W bands clearly marked, finished in white with green background. The special walnut escutcheon is easy to fit and requires an aperture of 3" by 3". This dial can be edge-lit.

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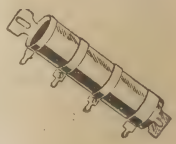

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closure would be just the thing, but such a suggestion is hardly in keeping with the space-saving design of the amplifier itself. Nevertheless, excellent results can often be had by mounting the speaker on a baffle across a disused chimney, in a section of a bookcase or in some such situation. However, avoid boxing in the back of the speaker too much. If the space behind the cone is restricted it is better to have some opening to relieve the air pressure rather than to have an air-tight seal. There is plenty of room for experimenting on this score.

SEPARATE SPEAKER

In principle, it is better to have a large speaker mounted separately than a small one tucked into the same box as the pickup and motor. Apart from the natural limitations of a small speaker and baffle, there is a chance of acoustic feedback occurring, particularly with a fully compensated lightweight pickup.

When connecting the pickup to the amplifier, attention should be paid to the manufacturer's recommendations in regard to the load, &c. Most of the lightweights appear to work best into a load of from 30,000 to 50,000 ohms and a resistor of the appropriate value should be clipped across the pickup terminals at the same time as the pick leads.

Other pickups require the use of a step-in transformer using a higher terminating load. The volume control in the pickup provides a 0.5 meg load in itself, so that to reduce the load to an effective 0.25 meg, for example, another 0.5 meg resistor would need to be connected in parallel with the pickup. In special cases a resistor/condenser combination may be required.

A lightweight crystal pickup may not require bass boost in the amplifier and it can be eliminated, as already outlined. A special pad may be required, however, to lift the treble and generally "shape" the curve. Suitable component values are usually given in the manufacturer's literature.

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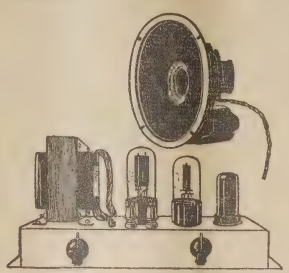

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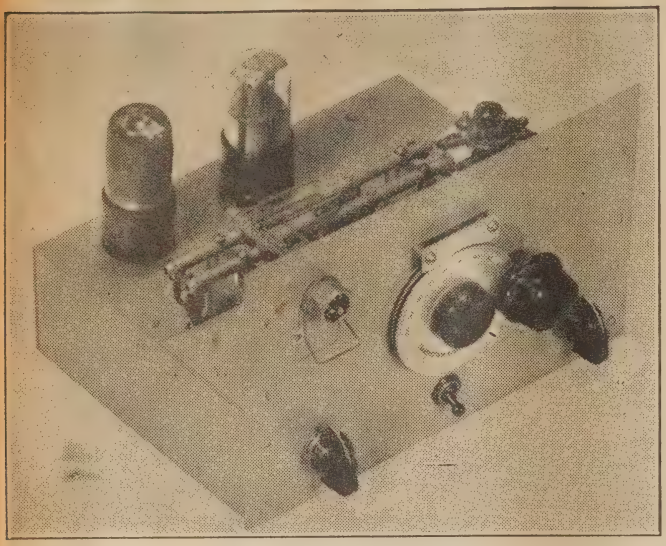


A general view of the receiver showing controls and positioning of the Lecher line.

At no time during the history of radio has the very-high-frequency spectrum been of as much importance as it is at the present time. The concepts of Radar, FM and Television are all closely linked with, and depend on, the properties of VHF radio waves for their operation.

by Maurice Findlay

ALONG with commercial radio, amateur radio operators have been gradually making more use of the higher frequencies. The normal high-frequency bands which are used for long-distance communication between amateur stations are very fully occupied, and communication is often more a matter of combating interference rather than propogating a signal.

However, among the ranks of the amateurs there are those to whom "working DX" is less attractive than experimental work and/or a friendly chat with a fellow-amateur across the other side of the city.

There is little point in these chaps adding to the overcrowding on the high-frequency bands, so that they are usually to be found on the VHF bands, where life is less hurried and there is plenty of room to try out new schemes.

AMATEUR BANDS

Four VHF bands are being regularly worked by Australian amateurs at the moment. The well-established 50mc band is a favorite with many. Stable crystal-controlled transmitters are easy to build, and superheterodyne receivers for 50mc present no difficulties to the average amateur. The 50mc band offers occasional DX as well as reliable cross-town communication. In recent months all Australian States have been worked, as well as New Zealand, and isolated cases of signals having been heard from much greater distances are on record.

The 144mc band has more recently become established with crystal-controlled transmitters and superheterodynes. It is a favorite with many because high-gain beam aerial arrays can be constructed in a limited space. The band is particularly well suited for mobile working, and many experiments along these lines have already been made by members of the VHF fraternity.

Most radio clubs choose the 144mc band for field-day activities, transmitter hunts, &c. On these occasions the advanced equipment is often left at home in favor of something lighter and more easily portable. Self-controlled transmitters and super-regenerative receivers make their appearance. Some enthusiasts, of course, are fortunate enough to be able to install elaborate equipment in their cars and take a very advanced 144mc station into the field.

The comparatively poor stability of the self-controlled transmitters and simple receivers is usually overlooked for the purposes of the field day. Most of the participants are able to take a reasonable, charitable view if a transmission occupies more of the band than a crystal-controlled signal normally would.

However, the general standard of transmissions on the 144mc band is gradually improving, and we imagine that it will not be very long before the standard on 144mc will be comparable with that on the 50mc band.

SUPERHET RECEIVERS

Superheterodyne receivers, &c., for 144mc are all very well in theory, but it requires quite an amount of time to build and adjust them for efficient operation—without considering the cost of the components.

Many of our readers are interested in the possibilities of VHF but have been prevented from carrying out active experiments for the above reasons.

Some are full-time students who wish to experiment with radio to get relaxation. Lack of time and hard cash prevent them from setting up an advanced station on either 50mc or 144mc.

However, the more recently opened 288mc band offers possibilities for such experimenters. While crystal-controlled transmitters and superheterodyne receivers can be and have been built for 288mc, there are not many who care to spend the time, or to outlay the money necessary. Therefore, 288mc is almost exclusively "populated" by simple equipment.

While a limited number of amateurs have conducted experiments on the 576mc band, we imagine that it will be some time before it is brought within the scope of every amateur.

576 MC

The chief difficulty at 576 mc is that many of the parts require special machining, and most amateurs are not in the fortunate position of having lathes and other machine tool equipment at their disposal. We will hear more of 576 mc later; but, at the moment, it is limited to a few experienced experimenters.

On 288 mc, however, there is little difference in the general approach to that required on 144 mc, except that the equipment is usually simpler. The linear tuning circuits almost invariably used on 288 mc are frequently used on 144 mc, and many of the valves which are used on 144 mc will also work on 288 mc.

As we have already mentioned, super-regenerative receivers are almost exclusively used on 288 mc. They have the advantage of extreme

simplicity. The very high amplification which is obtained in a single stage is also a strong point in their favor. However, weighing against their advantages, super-regenerative receivers have relatively poor selectivity when compared with superhets. The tendency for the frequency to change with a change in aerial loading is another disadvantage which sometimes rules them out of favor.

BROAD SIGNAL

A super-regenerative receiver tends to radiate a broad signal, and on crowded amateur bands this is perhaps its most serious disadvantage. Excessive radiation can be avoided by operating the detector just on the verge of super-regeneration and coupling the aerial as loosely as possible.

Some super-regenerative receivers include an RF stage to minimise both these defects. However, this involves a substantial increase in cost and adjustment required, and we did not consider it warranted in a simple design.

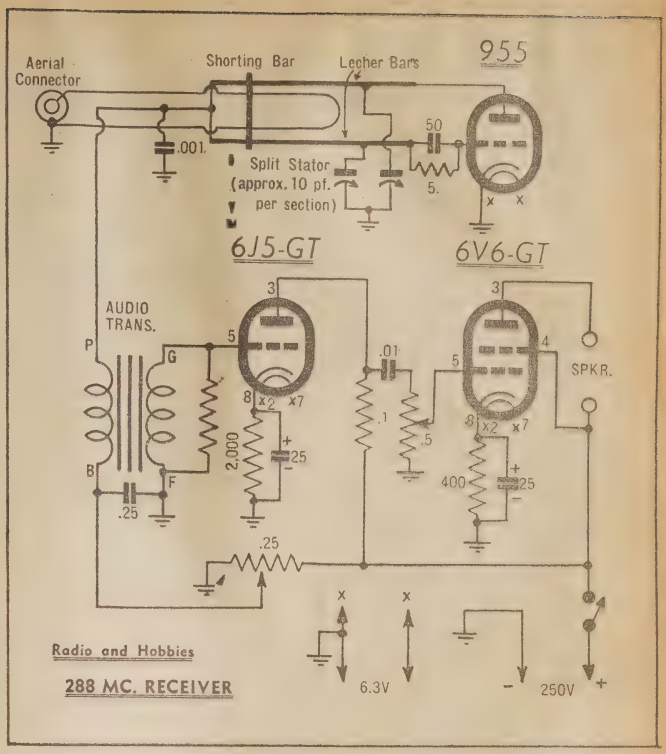
As the regeneration control is advanced, the receiver should slip smoothly into oscillation. Oscillation is indicated by a continuous hiss. When a signal is tuned in, the hiss will be attenuated or disappear entirely, depending on the strength of the signal. The smooth hiss indicates that the receiver is operating correctly. Actually it is the thermal noise of the tuned circuit amplified tremendously.

The gain of the receiver is slightly higher when the aerial coupling is tight and the regeneration control has to be advanced to make the detector oscillate. However, care should be taken to advance the coupling only as far as necessary to copy a weak signal, in order to avoid interference in neighboring receivers.

AERIAL COUPLING

The degree of aerial coupling is quite important, and we often see receiver designs which include a separate aerial coupling control. However, it is not often the coupling need be altered after the optimum setting has been found. In any case, it is quite easy to bend the coupling loop in relation to the tuned circuit when necessary.

By the way, for transmitter hunts, &c., where it is desired to use a super-regenerative receiver for direction-finding with a beam, a meter can be included in the plate circuit of the detector. The current is in the order of 100 microamps with no signal or a very weak signal, and drops in proportion to the strength of the signal. A 0-1 mA meter will give quite a reasonable indication. This method is to be preferred to connecting an audio meter in the output circuit, since a super-regenerative detector exhibits a very strong AVC characteristic, which tends to make audio readings difficult to follow. Incidentally, the AVC and noise-reducing properties of super-regenerative receivers are very valuable for mobile working.



A great advantage of the super-regenerative circuit is its extreme simplicity.

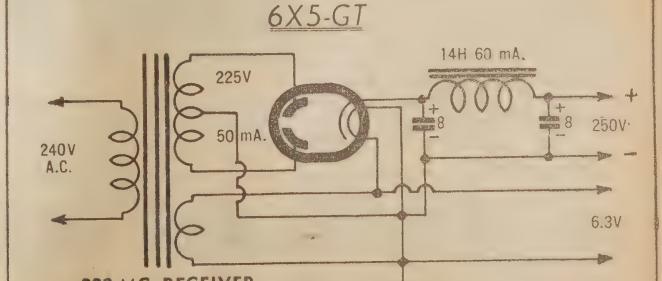
The theory of operation of super-regenerative receivers is very interesting, and has in the past been the subject of much controversy. As soon as space permits we will make it the subject of an article.

Our receiver, which can be considered a standard design for 288 mc, consists of a super-regenerative detector with a linear tuning circuit, and audio voltage amplifier and an output stage for speaker operation. The output stage, incidentally, may be omitted if the receiver is required for headphone operation only.

Actually, a conventional coil and condenser arrangement could easily be used, but the efficiency would be very much less than with the arrangement we have adopted.

We have used a split stator type tuning condenser which happened to come from a piece of military equipment. However, any small split stator condenser with a capacity of about 10 pf. per section is suitable. If the condenser is of the "butterfly" type it may be necessary to make some slight modification to the layout, but it should not be difficult to make the leads of similar length and tapping in to the same point.

The matter of layout and short leads becomes more important as frequency is increased. An inch or two of connecting lead which may



Any simple power supply giving about 250 volts will do. Here is a typical circuit.

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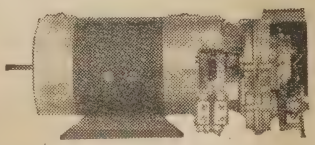

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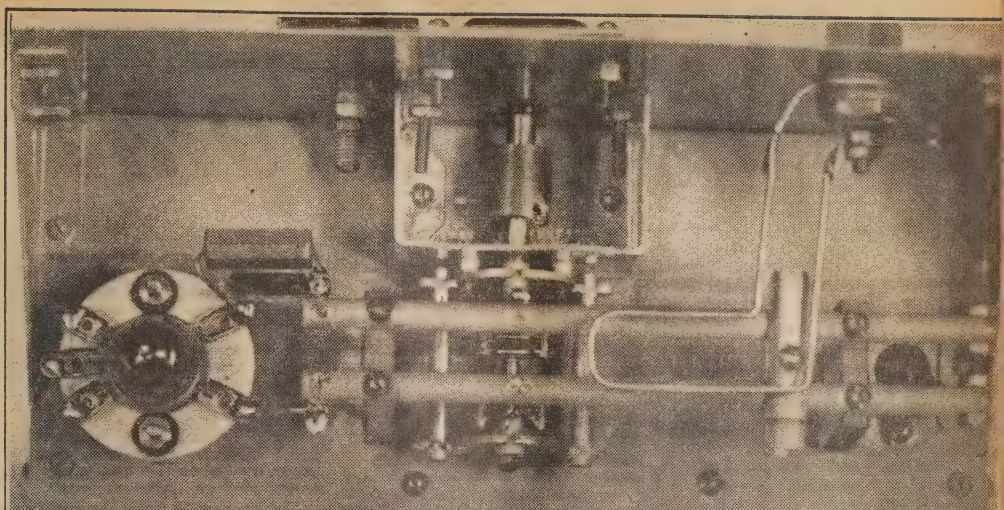

A close-up of the Lecher lines. They are ¼ inch in diameter, 5½ins long, and spaced ⅝ inch centre to centre. They are mounted on tapped polystyrene blocks 1 3-8ins high, about ½ inch from each end, the hot end being ½ inch from the socket. Our shorting bar was 3½ins from the hot end to hit 288mc. The tuning condenser is attached to the bars 1¾ins from the hot end.

be quite unimportant at normal shortwave frequencies may be vital at frequencies in the order of 300 mcs. The layout of our set has been carefully planned with all these points in mind.

For the detector valve we chose a 955. This valve allows a good layout and is cheap and easy to obtain at the moment. Type 9002 is directly equivalent to the 955 and may be substituted for it without modification to component values. It would be necessary, however, to make up a special bracket for mounting the 9002.

VALVE TYPES

There are a number of other types which could be used and which would operate with varying degrees of efficiency. Some of these are: 6C4, HY615, 7193, &c. With substitute valves it may be necessary to experiment with the value of the grid leak resistor and the condenser bypassing the centre tap of the tuning circuit. Values of from 1.0 to 10.0 megohms may be required for the former and from .0005 to .005 mfd for the latter. Actually, it is a good plan to experiment with these components in any case to obtain optimum performance under varying working conditions.

The detector is coupled to the voltage amplifier via an audio transformer. Note that there is a .1 meg resistor loading the secondary of the transformer. This is necessary to prevent howling when the set is adjusted to the verge of regeneration. Practically any audio transformer may be used as its characteristics are not very important. The transformer is mounted under the chassis near the 955.

As a matter of fact, if you happen to have a transformer with a burnt out primary or secondary the winding which is intact may be used as a coupling choke. In an emergency the primary winding of a speaker transformer may be used in the same way. The coupling condenser may be .02 mfd or thereabouts and the grid return resistor for the 6J5-GT .1 meg.

REMAINING STAGES

The remaining amplifier stages are quite conventional and require little comment. Practically any general purpose triode may be used in the first stage without change to the circuit values. We didn't happen to have a spare 6J5-G on hand for the original receiver so, rather than buy a new valve, we used one section of a 6SN7-GT and simply ignored the remaining section. Type 6SN7-GT is actually two 6J5's included in a single envelope.

Practically any pentode or tetrode output valve will serve without modification to the circuit. The valve is overbiased for economy. The full power output is not required and current consumption is important when the set has to be operated for hours at a time from an accumulator and vibrator supply.

OTHER VALVES

If you use a high transconductance output valve, such as the EL33A or KT61, the bias resistor may be reduced from 400 to 300 or 250 ohms. In the latter case a grid stopping resistor of about 10,000 ohms may be necessary to prevent parasitic oscillation. A screen blocking resistor, of 100 ohms could also be included.

Do not attempt to include the power supply on the same chassis as the receiver since the coupling between it and the audio transformer will cause hum, which is very difficult, if not impossible, to eliminate. We suggest that you construct the AC power supply on a separate chassis and connect it to the set via a short cord. Mount the plug on the chassis and the socket on the end of the cord. This prevents the possibility of shock should the power supply be switched on without the set connected. The separate power supply makes it possible to substitute a set of batteries or a vibrator supply easily should the need arise.

The AC power supply we have suggested uses a recently released transformer with a 225V secondary and a single 6.3 volt filament winding. With this transformer and a 6X5-GT rectifier the output from the filter is approximately 250 volts.

AERIALS

At 288 mcs aerial consideration are most important. An ordinary dual wave receiver will operate quite well with a few feet of wire suspended around the living-room picture rail. However, if you try this approach with 288 mc receiver you will be very lucky to receive any signals at all. Some form of resonant aerial is required. Also, since radio waves at these frequencies tend to travel in straight lines, it is desirable that the aerial be mounted as high as possible.

It is important that the aerial for the transmitter and receiver both be mounted in the same plane whether it be horizontal or vertical. Actually there are arguments in favor of both methods of polarisation, but vertical is generally used on 288 mc. This is mainly due to the difficulty of mounting a non-directional horizontal aerial on a car or a hand portable set.

Here's your answer, Tom!

Tom has apparently got himself a valve manual and made some effort to study the hundreds of types listed. He reasons that there must surely be some system which dictates the choice of valve numbers—some key which would enable him to recognise types at a glance. It is our unfortunate "privilege" to disillusion him.

WE can guess at the train of Tom's thoughts by the text of his first question:

How are valve type numbers selected and what may be learnt from them?

We can quite sympathise, Tom, with your desire to discover the key which will unlock the mystery of

valve type numbers. The trouble is there are so many darned keys that it's difficult to find the right one to begin with.

You see, many production chiefs have appreciated the difficulty of identifying valve types and have produced their own ingenious systems of numbers and letters. They are all intended to give to the uninitiated some hint as to the type of valve which the number refers to.

Unfortunately, the large numbers of valves coming forward have ultimately exhausted the possibilities of each system in turn, with the result that they have been amended to such an extent, or sprouted so many suffixes and prefixes, that only a shadow of the original has remained.

Apart from remembering a few outstanding practices, therefore, we are inclined to suggest that you rely entirely on your book to identify the valves for you. Gradually you will become familiar with certain type numbers and be able to remember at least the most important ones.

European valve makers have their own numbering systems, but to date the Philips and Mullard series are the only ones which bear a Continental numbering system and are widely used in this country.

Briefly, their system uses a combination of two or three letters and one or more figures. The first letter indicates the heater voltage: A being 4, E being 6.3, and K indicating a two-volt battery valve. C is for a 0.2 amp series of AC/DC valves, while U is for a similar 0.1 amp series.

The next letter or letters indicates the electrode combination: A standing for one diode, B for two diodes, C for a triode, L for an output valve, and so on.

The final figure is the serial number. Thus type EBL1 is a 6.3 volt double-diode-pentode output valve, the first in its class. Knowing this much, Tom, you should be able to have fun and games with the Continental type numbers based on this system.

Crossing the Atlantic to the US, our American friends were content for a long time to allot to all valves a simple serial number, so that we have the familiar 24, 57, 59, &c. — numbers which mean nothing in themselves.

Subsequently, an association of manufacturers invented a system of figures and letters in which the first indicated the heater voltage, the letters represented the serial number and the final figure the number of active electrodes. Thus the number 6C6 indicates that the valve has a 6.3 volt heater and six electrodes, but it could be anything from a twin triode (6A6) to a double-diode-triode (6B6) or a straight RF pentode (6C6).

Since there are only 26 letters in the alphabet it is not surprising that the letter serial system has proved inadequate, so that we find ourselves talking about 6BA6s, and so on.

As for the suffix, the "—G" indicates that the valve is of glass construction and fitted with an octal base. "—GT" indicates that it is of still similar glass construction and once again fitted with an octal base. In the absence of a suffix you can assume that the valve belongs to the pre-octal era or is a metal valve or is one of the new all-glass miniatures. Thus armed you can have some more fun and games, Tom.

Rubber has insulating properties. In the case of an aerial made of insulated wire how do the radio waves get through the rubber?

That's a question that has puzzled quite a few beginners, particularly those who have been brought up in the best traditions of electrical wiring.

When dealing with simple electrical systems metallic contact is necessary between wires, plugs, &c., to complete an electrical circuit.

The energy in radio waves, however, is contained in electromagnetic and electrostatic fields which can exist in space and are not impeded by ordinary insulating materials. For example, a magnet will attract a needle through free space or through a wooden table top, for that matter. In just the same way you can pick of scraps of paper by rubbing a fountain pen on your coat sleeve—an old schoolboy trick!

Radio waves have these same properties. They can induce currents in a wire suspended in free space, irrespective of whether it is insulated or not.

What books are necessary to study for an amateur transmitting licence?

Before we say another word, Tom, let's hope you have cleared up the social implications of your question.

Any man who contemplates setting up an amateur station should either

be single, or hold his wife in complete subjection, or be married to someone as technically crazy as himself. Of course there are times when an amateur station can be a blessed retreat, with only 562 voices to listen to—all male!

To judge by your previous question, Tom, you will have to do a

heck of a lot of "swot" before the coveted ticket becomes yours. Not that the AOCP examination is a particularly tough one in the realm of technical accomplishment, but it is well removed from the starting point!

Get hold of an elementary textbook and learn as much as you can of the basic principles of radio theory. At the same time study current radio magazines and make an effort to build some of the sets described, beginning at the simpler ones.

When you think you know the score on this plane, purchase a book like the ARRL Handbook, go through the elementary theory again and then study the chapters on typical "ham" gear. At the same time you must purchase and study the PMG Handbook on operating regulations and learn to send and receive Morse code at 14 wpm.

After that there is nothing to it!

Can a transmitting set be operated economically using dry batteries? If so, how many would be needed?

The idea of a battery-operated transmitter—that is, dry batteries—is not a particularly attractive one, Tom, because the amount of RF power available would be so small.

You would have to use heavy duty 45-volt batteries, and four of them, connected in series, would provide 180 volts. You could not afford to draw more than about 20 milliamps, representing a total power load of 3.6 watts.

For CW operation, a little more than half this would be available to the final amplifier, while only about one-quarter would be available in the case of a voice transmitter. Contact is not by any means impossible with one or two watts input, but the competition with stations up to 100 watts power is a bit tough.

If you can't get your hands on a power line (figuratively speaking) the best bet is a motor generator or a vibrator supply, with a windmill or a petrol motor or such like to keep batteries charged. Quite a lot of motor generators have been floating around on the disposals market lately, which would be suitabe for this job.

What would be the cost of a transmitter capable of working overseas amateurs?

I think the appropriate answer to such a question, Tom, is a lemon. Leastwise, that is what people say.

Very few amateurs decide to build a certain transmitter and then proceed systematically to buy all new parts. Once having got the disease, the usual procedure is to haunt "junk" shops digging up bits and pieces which are either directly suitable or else capable of being modified to use in a transmitter. Many receiver tuning condensers, for example, can be stripped down and double-spaced to make excellent transmitting condensers.

The final "rig" represents the best circuit which can be built up, using the majority of components so collected.

A good 15 or 20 watt transmitter will give you overseas contacts and, together with receiver, might cost anything up to £100 if a lot of the stuff had to be bought new.

Our guess is that the majority of amateurs get out of it for less than half that, spent over a period of 12 or 18 months in buying odd bits of the proverbial "junk." Unless you are in a particularly remote area, the business of collecting the necessary parts will be the least of your worries.

How many valves would be the absolute minimum to establish overseas contacts?

It would be hard to answer that question accurately, Tom, because so much depends on circumstances. It might be possible to hear an overseas amateur on a one-valve regenerative set, but we could hardly condemn an amateur to the everlasting use of such a device. Really the smallest practicable set would be a three-valve TRF regenerative job but, in practice, most amateurs find it desirable to use sets having at least five valves.

A CW transmitter might have only two valves, with at least another two valves for a speech modulator. Add a couple of rectifiers for AC operation and the total adds up to eleven.

Thus a modest station might use anything from eight to twelve valves, all told, although a more elaborate set-up could easily have double that number.

In an ambitious station with several transmitters, receivers and various items of test equipment, the total complement can easily run up to 50 or more—valves which have been variously "won," scrounged, or simply paid for at odd times at sundry places.

Radio parts are funny that way. You start out with just a few and, before many years elapse, they are stacked everywhere from the front bedroom to the back verandah.

PS: We suggest you remove these pages before the budding XYL sees them!

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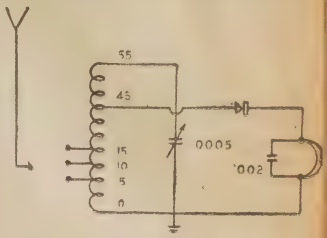

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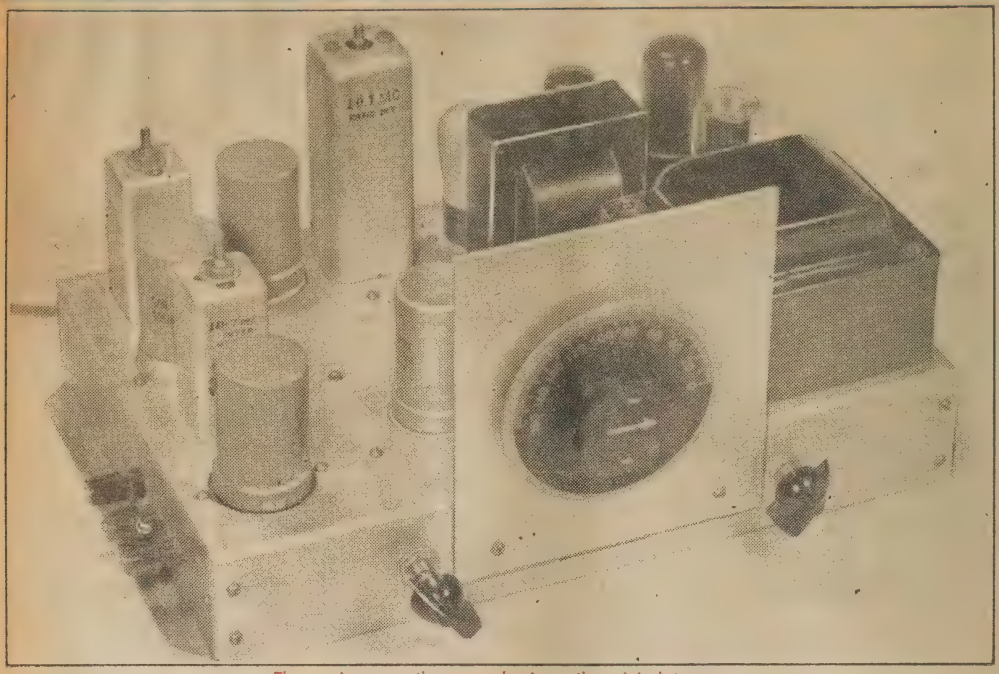


The receiver uses the same chassis as the original tuner.

ENLARGING YOUR FM TUNER

Based on the original R & H F. M. Tuner, this new circuit will allow you to build up a complete F. M. receiver from inexpensive disposals parts. For those interested only in the F. M. tuner, instructions are given for altering the layout and generally improving the performance.

THE original tuners, featured in November, 1948, and January, 1949, were built at a time when the policy towards FM, technical and otherwise, was not clearly known.

The tuners were deliberately arranged to use parts which, if not already on hand, could be obtained cheaply from Disposals sources. The chassis layout was such that a variety of valve combinations could be accommodated and there was sufficient room for an RF stage. If required, a small tuning-gang could have been employed, along with miniature valves.

The chief point of difference between the two versions was in the choice of discriminator, the first using a ratio detector and the second a modified Foster-Seeley circuit. There was little to choose between the two circuit arrangements, although we imagined at the time that the Foster-Seeley set-up, with no AVC and an IF limiter, was slightly the easier one to handle.

Sufficient to say that the tuner, in its later form, has had plenty of use since then and proved to be an excellent proposition. It has demonstrated that an RF stage is unnecessary, except in poor locations, provided a high-gain pentode mixer is used rather than a conventional converter valve.

Appreciating this point, we recently spent a few hours modifying the layout of the original tuner and eliminating the compromise made necessary by the original idea of versatility.

There was no special intention to publish the results, but the improvement does warrant a mention. Those who have the tuner in operation may care to modify the layout as indicated. Others who may have the urge to use up a few spare parts should follow the improved layout rather than the original. As far as the tuner is concerned, no changes whatever are necessary in the electrical circuit.

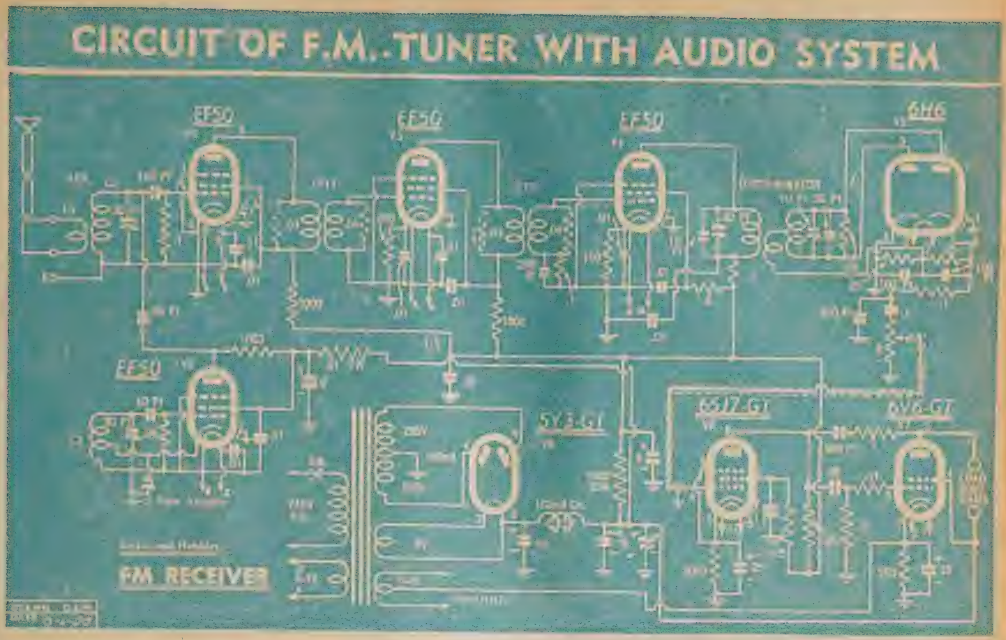
by Derrick Williamson

OSCILLATOR CIRCUIT

As can be seen from the photographs, the EF50 oscillator has been moved to the position originally occupied by the mixer, while the mixer has been moved into line with the first IF transformer.

The aerial and earth terminals have been placed on the side of the chassis, and a small piece of aluminium has been used to cover the unused oscillator valve-hole. The mixer grid coil and aerial coupling coil have also been moved to the side of the chassis. This rearrangement of parts allows for very short leads, and is the logical layout to match the electrical design.

CIRCUIT OF F.M.-TUNER WITH AUDIO SYSTEM



The circuit shows how the audio stage has been added to the tuner.

When modified in the way shown, the need for a shield between the IF amplifier and the oscillator completely disappeared, and it was found that the oscillator injection to the mixer could be increased, giving higher conversion gain. It was also easier to align the set, since the new layout had completely removed the last trace of regeneration around the IF channel.

COMPONENT PLACEMENT

The accompanying coded photographs show clearly the layout of the components on the chassis, and should enable any intending constructor to build either an FM tuner or the complete receiver. The main difference between the two is the audio system, which involves two valves—the 6SJ7-GT and the 6V6-GT. The power transformer for the tuner is rated 225 volts per side at 40 or 50 milliamps, while the choke can afford to have the same modest current rating. A 6X5-GT rectifier is used.

One other point is that decoupling of the oscillator is unnecessary with only a tuner operating from the power supply, since there are no audio pulses present to promote instability.

We need not say too much along this line, however, since most readers will have the earlier issues on hand and can turn back to read through the accompanying articles.

Having gone so far with the modifications and produced an inexpensive tuner which was capable of outstanding results, we decided to add a simple audio amplifier, thus making a complete FM receiver. You may care to follow our lead.

The first job was to replace the power transformer with a new one having a rating of from 80 to 100 mA and delivering a voltage output of 285 per side.

To mount this transformer it was necessary to cut a hole, of sufficient size to clear the windings in the chassis. However, this would not be necessary if a vertical transformer were used, it being necessary only to drill the mounting holes and two larger holes to allow the leads to pass through the chassis.

A vertical transformer is actually to be preferred, since it will produce fewer eddy currents in the chassis and allow more room for

PARTS LIST

1 Chassis 12" x 8" x 2".
1 Power Transformer 285/285V 80 or 100 mA., 6.3V 3A., 6.3V C.T. 3A., 5V 2A.
1 100 mA choke.
2 10.7 Mc. I.F. Transformers with built-in loading resistors.
1 10.7 Mc. Ratio Detector transformer.
4 Octal valve sockets.
4 Nine pin valve sockets for EF50 valves.
3 Terminals (2 red, 1 black).
1 Miniature four pin speaker plug and socket.
Small quantity of 16 g. tinned copper or silver plated wire for coils.

VALVES
4 EF50 (VR91), 1 6H6, 1 6SJ7-GT, 1 6V6-GT, 1 5Y3-GT.

CONDENSERS
2 25 mfd 40 PV electrolytics
2 16 mfd 525 PV electrolytics.
2 8 mfd 525 PV electrolytics.
1 .25 mfd 400 V tubular.
2 .25 mfd 400 V tubular.
1 .05 mfd 400 V tubular.
10 .01 mfd mica or 400 V tubular.
2 500 Pf mica.
1 200 Pf mica.
3 100 Pf mica.
1 50 Pf mica.
5 3-30 Pf air trimmers.
2 10 Pf mica (may not be necessary with some ratio detector transformers).
1 2 plate midget variable.

RESISTORS
1 1.5 megohm.
1 1 megohm.
2 .5 megohm.
1 .5 megohm potentiometer.
3 .25 megohm.
4 .1 megohm.
1 .05 megohm.
1 .04 megohm.
1 .01 megohm 2 watt.
1 .01 megohm.
1 2000 ohms.
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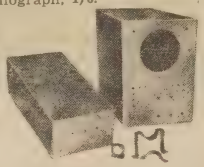

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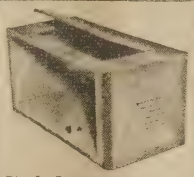

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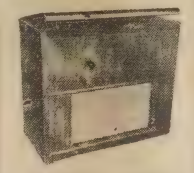

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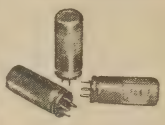

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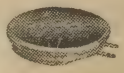

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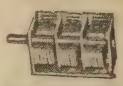

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other components. As it is, there is plenty of room for a large filter choke and, in the interests of hum-free operation, we suggest you use a choke with plenty of iron in the core. With a medium-sized choke, as shown in the photographs, the hum level was noticeable. However, this could be very much reduced by the addition of an additional 16 mfd electrolytic condenser as shown by the dotted lines in the circuit diagram.

While on the subject of hum it was noticed that with the volume control fully advanced, a nasty hum would appear. This was finally found to be coming directly from the 6H6 discriminator.

We were very puzzled about this because there had been no trace of hum in the original tuners or in the eight-valve FM receiver described recently. After a little, thought we remembered that the same 6H6 was used in all of these receivers and that we were now using a different tube. We thought that the tube in use must be faulty. However, replacing it with several other tubes did not cure the trouble, although there was a marked difference between one tube and the other. The heater leads to the valve were then reversed in an attempt to reduce the noise, but this had no effect.

HUM TRICKERY

It was discovered, however, that by connecting a potentiometer across the heaters and earthing the centre arm, that a good deal of the hum would disappear at a critical setting of the control. This did not completely cure the trouble, however. We then decided that the trouble might be caused by emission directly from the heater to the cathode, and, if this was so, it should be possible to considerably reduce the trouble by returning the heater winding to a positive point.

This worked wonders, and the hum virtually vanished. A little experiment proved that the voltage was not critical, anything between 10 and 15 volts being satisfactory. It is important not to have the voltage too high, as this can cause emission to take place from cathode to heater, while there is also the insulation inside the valve to consider.

In the interests of simplicity the whole of the audio amplifier, including the 6H6, was connected to the 6.3V centre-tapped winding, and the centre tap was returned to the 6V6-GT cathode, which is approx. 15 volts positive with respect to earth.

FILAMENT WIRING

All the remaining filaments are run from the second filament winding and have been marked with the sign X in the circuit diagram to avoid confusion.

If the transformer you use has two 6.3V windings, neither of which are centre-tapped, it will be necessary to use two resistors to form a centre tap. The value of these resistors is not critical, and anything between 25 and 50 ohms should be satisfactory. The rectifier valve has also to be changed to a 5Y3-GT to accommodate the extra current drain.

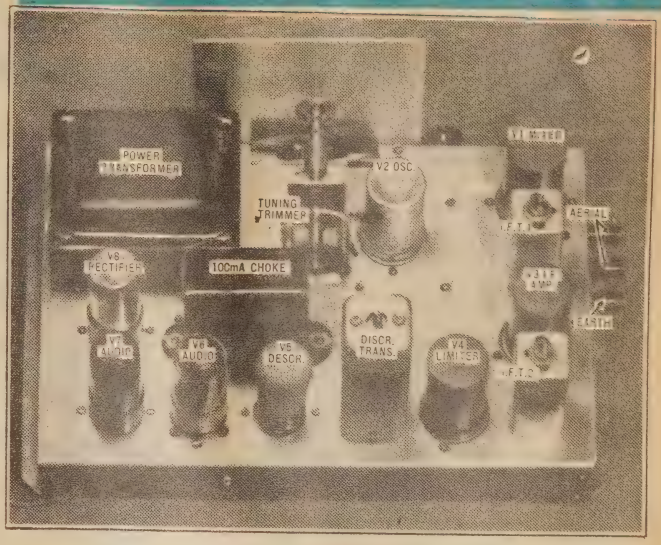
And now for a look at the audio circuit.

The audio amplifier is of straightforward design and incorporates negative feedback and a small amount of fixed bass boost. This later feature very much enhances the tonal quality at low listening levels. If, however, you do not require this bass boost, a switch could be fitted to short-out the 500 pF condenser. Alternatively, if desired, the bass boost could be made continuously variable by wiring a 1 megohm potentiometer in the form of a rheostat across the feedback condenser.

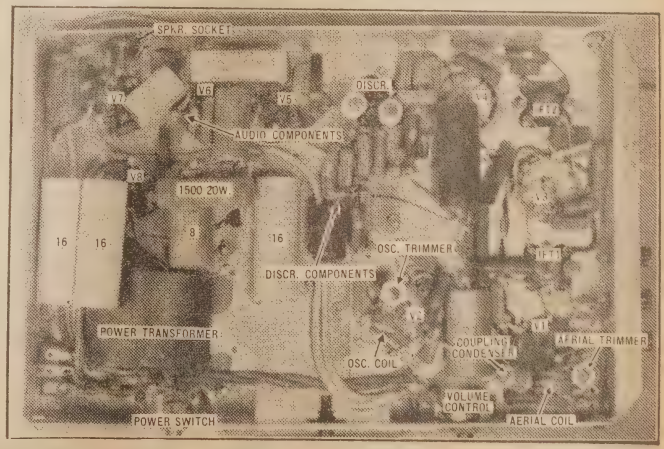
The plate and screen volts of the 6V6-GT are taken directly from the output of the filter choke, the voltage at this point being approximately 280. Under these conditions the output stage will deliver approximately 5.5 watts of output at the commencement of grid current.

The 6SJ7-GT is wired as a straight resistance capacity coupled amplifier with the plate and screen supply voltage being taken from the

TOP CHASSIS VIEW OF THE SET



This picture illustrates slight re-arrangement of the tuner and positioning of audio components.



Placement of maior underchassis components is shown here.

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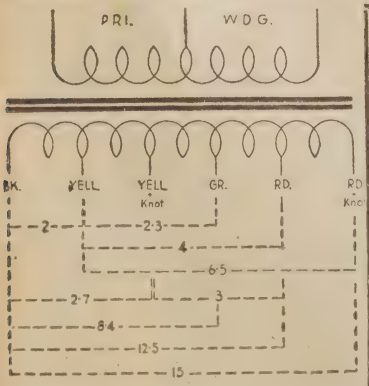

TYPE	PRIM. Z	WATTS
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OP 55	5000 PP	15
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OP 58	5000 6600 10000 PP	15
OP 59	5000 6600 10000 PP	25
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output side of the 1500 ohm dropping resistor.

This resistor is included to drop the voltage on the plates and screens of the EF50 valves to the same value as was originally supplied by the smaller tuner power supply. This is approximately 240 volts. The resistor, in conjunction with an 8mfd electrolytic, also forms an effective decoupling network for the 6SJ7-GT voltage amplifier.

The resistor used should be a large one, as it has to carry the best part of 30 mA. We advise the 20-watt type as it is little dearer than two five-watt units, which, in parallel, would be required to dissipate the power. It naturally has a much greater margin of safety.

When first switched on it was found that the receiver tended to motor-boat when the volume was advanced or on heavy bass passages. The bass notes were also accentuated as though heavy bass boost was being used.

OSCILLATOR MODULATION

After carefully checking the audio amplifier it was found that the trouble was caused by modulation of the oscillator circuit. It was decided to decouple the oscillator supply voltage by feeding it directly from the rectifier filament through a 10,000 ohm 2-watt resistor and bypassing it with an 8mfd. electrolytic condenser. This effectively stopped the motor-boating trouble, but there was a tendency for the set to produce modulation hum when tuned to the station. This hum was completely removed by returning the decoupling resistor to the output side of the filter choke.

You will notice from the circuit diagram that the de-emphasis condenser has been increased from 200 pF, as used in the original tuner, to 500 pF. The reason is that the original tuner was left with insufficient de-emphasis to offset any losses that might occur when a length of shielded wire was used to connect the tuner to an amplifier. However, as the length of shielded wire used in the receiver is small, the de-emphasis condenser has to be increased to compensate for it.

The tuner circuit once again uses a Foster-Seeley discriminator as a detector, preceded by a limiter stage. We have again used this circuit because it is somewhat less difficult to align with a standard oscillator than is the ratio-detector. However, in practice there is little to choose between the two from the point of view of performance.

RATIO DETECTOR

The ratio detector allows the use of two straight IF amplifier stages for a given number of valves, while, with a discriminator, one of these stages has to be used as a limiter, contributing much lower gain.

From this it might be assumed that a receiver using a ratio-detector would be more sensitive than one using a discriminator. In practice, however, there is little to choose, since the audio resolution of the discriminator is very much better than that of the ratio-detector. In other

Continued on page 83

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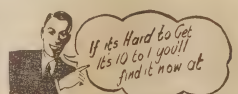

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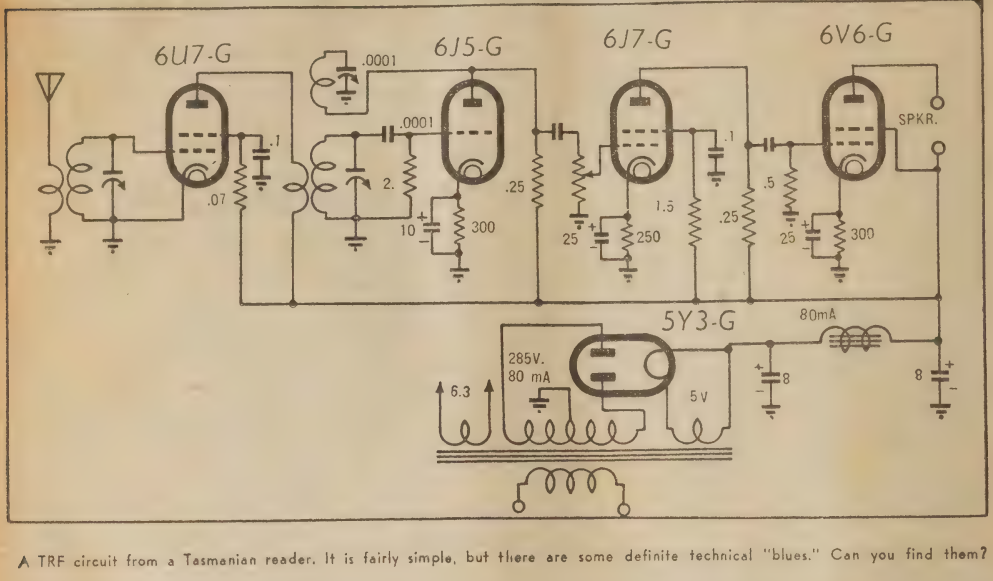


A TRF circuit from a Tasmanian reader. It is fairly simple, but there are some definite technical "blues." Can you find them?

Two readers, in a valiant effort to draw up their own circuit, have made just about all the mistakes in the book. We comment on their efforts, not for the sake of being critical, but to guide other readers who have the urge to "roll their own."

THE first circuit comes from a 16-year-old Sydney lad who says: "I have taken a few hints from various circuits . . ." He certainly has, but is obviously not very clear on the implication of the various components and connections.

The circuit sent in for comment is of a five-valve superhet with the important difference that it boasts an extra IF stage instead of the usual audio voltage amplifier. This is quite all right, although it is certainly an unusual way to employ five valves. However, in detail the circuit does not stand up to close examination.

A.V.C. BYPASS

The first mistake concerns the value of the AVC bypass on the aerial coil, which is shown as .01 mfd. This is much too small, the usual value being .05 mfd.

The AVC bypass is effectively in series with the tuned circuit and calculation will show that the connection of a .01 mfd condenser in series with a 425 pF tuning gang reduces the effective capacitance of the latter to about 408 pF—sufficient to upset the tracking with the oscillator coil. The use of a .05 mfd bypass, on the other hand, only reduces the value by about 3 pF, which is negligible. Still higher values are undesirable because they produce a long time constant and make the AVC sluggish in its action.

A low value of AVC bypass can be permitted in UHF receivers or in IF stages, where the condenser is not actually in series with the tuned circuit. The only point to watch is that the bypass is not made so small that it becomes ineffective and allows instability to develop.

Stick to .05 mfd in all broadcast and dual-wave sets and you can't go far wrong.

OSCILLATOR CIRCUIT

Coming to the next point, the whole oscillator circuit is completely confused. The oscillator grid is earthed, whereas it should go through a 50 or a 100 pF condenser to the tuning gang and the "G" terminal on the oscillator coil. The oscillator anode should go through the feedback winding to its HT supply, while the screen should be fed through a dropping resistor from B-plus and bypassed to earth with a 0.1 mfd condenser.

The two windings on the coil are also wrongly depicted, the condenser tuning the larger coil.

Incidentally, there is no such valve, as far as we know, as the 6A8-GT. We have seen metal ones and the normal glass ones, but never a "GT" version.

Coming to the 6S7-GT, the first obvious point is that you provide no initial grid bias since both cathode and grid return ostensibly to earth. The screen supply resistor is also much higher than need be and, if a value as high as 0.25 meg proves necessary to combat instability, it would denote either very poor layout or the use of unsuitable IF transformers.

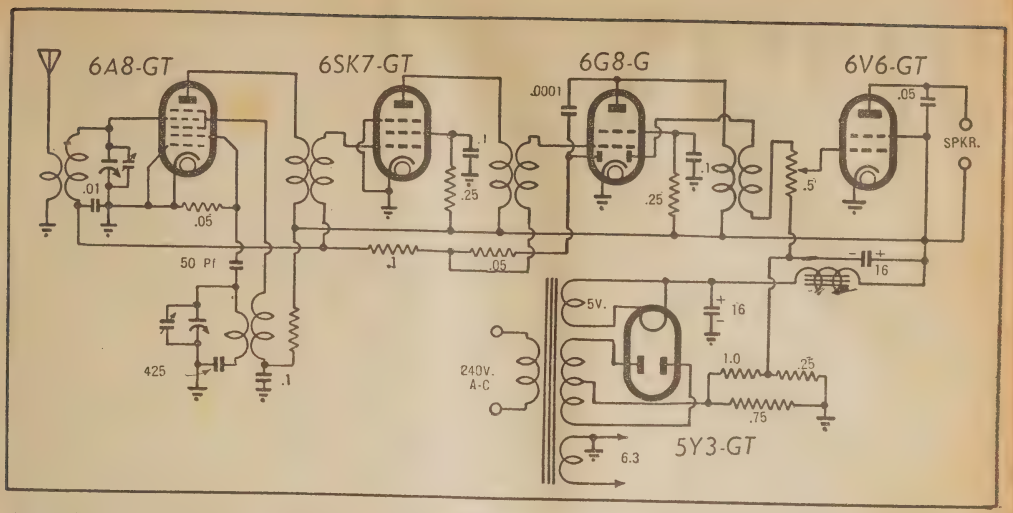
In any receiver having two normal IF stages it is essential to use low gain transformers intended for just this class of service.

The same remarks apply to the 6G8-G and the choice of its screen resistor. Assuming that the HT line carries about 250 volts, the screen resistor must provide a drop of 150 volts, if the remaining screen potential is to be 100.

By Ohm's Law a resistor of 0.1 meg is necessary to produce 150 volts drop at the rated screen current of 1.5 milliamps. It is quite true that screen resistors of up to 2 megohms are found in association with the 6G8-G, but the higher values almost invariably occur when it is used as a resistance coupled pentode and under operating conditions quite different from those which apply here.

VALVE TYPES

The suggestion was made incidentally in the covering letter, that the 6G8-G could be replaced by a 6AR7-GT and the 6A8-G with a X61M; higher gain being available in each case. Actually, the amount of gain already available in the IF channel will be ample, so that not much can



Here's the circuit of a 5-valve superhet, evolved by a Sydney reader and submitted to us for comment. Check through it yourself before you read our verdict.

be said in favor of upsetting things to use still "hotter" tubes.

Coming back to the circuit, the 6G8-G is operating also without an initial bias and, in any case, the AVC circuit is wrong.

There is no actual d-c path between the AVC diode and earth, so that the circuit lacks an earth return both for the diode and the three grids which it controls. Also, there is no bypass at the "F" terminal of the second IF transformer.

To put the circuit right, it would be necessary to run a 1.0 meg. resistor from the AVC diode to a point equivalent to —3.0 volts on the back-bias network. Another 1.0 meg. resistor could then run from the same diode to the "F" terminal on the second IF transformer, being bypassed with a .05 mfd. condenser. From this point, a further resistor and condenser could supply AVC bias to the first two grids.

DETECTOR

The detector circuit is also astray since the detector diode has no separate load circuit. At the very least a resistor of about 0.5 meg. should run back to the 6G8G cathode, being bypassed with a condenser of between 100 and 250 pF.

Then, to keep the 6V6 grid bias off the detector, it would be necessary to insert a .05 mfd. blocking condenser between the "F" terminal on IFT3 and the top of the volume control. So much for that!

The .05 mfd. bypass between plate and screen of the 6V6 is far too high in value and would lop off so much of the treble response that the result would scarcely be intelligible.

Then, too, the back-bias circuit is confused. Since somewhere between 12 and 15 volts is required as bias for the 6V6-GT, the back-bias resistor would need to be about 200 ohms, assuming a current drain of 70 milliamps. Thus the resistor marked ".75" should be 200 ohms and the grid of the 6V6 should return to transformer centre tap, representing the point of maximum bias.

The 1.0 meg and the 0.25 meg resistors would pick off about one-fifth of the total bias—just under 3 volts, and this could form the return point for the AVC circuit.

Last, but not least, the first 16 mfd. condenser should return to transformer centre tap, rather than to earth.

In the event of hum level still being high, another condenser may be worthwhile between the B-plus line and earth or alternatively a 25 mfd. condenser could be installed in parallel with the back bias resistor.

So much then, A.N., for your circuit. We could not avoid being rather hard on you, but you should have an interesting couple of hours work putting things right. If you like to submit the circuit again, we will see how close you come to being correct at your next attempt.

The second circuit, submitted by a reader from Tasmania, is essentially a simpler design, but also shows quite a few errors.

In the first place, he also has forgotten to provide bias for the first RF amplifier—a 6U7-G. Since there is no question of an AVC system, the bias would have to be provided in the cathode circuit involving, at the very least, a 300 ohm resistor and a 0.1 mfd. bypass.

OVERLOADING

There is more to it, however, in that the detector would tend to overload if the set were used in the vicinity of a strong local station. This may make it necessary to provide also a 10,000 or 15,000 ohm potentiometer in the cathode circuit to allow the gain of the RF stage to be reduced as necessary.

The screen resistor is of the right value, but the suppressor should be shown connected to the cathode, since it is brought to a separate base pin in the 6U7-G.

Coming to the detector, the bias components should actually be omitted, since the valve is obviously intended to operate as grid leak detector. Earth the cathode directly.

It would be wise also to include an RF choke in series with the plate supply, bypassing the load end with a 250 pF condenser. Although the set may operate without these components in place, their presence is a guarantee of more consistent performance.

In the 6J7-G, which follows, the suppressor connection has also been omitted, and, as a point of interest, pin 1 should be connected to earth, since it is joined to the internal shielding. Plate and screen components are right, but the bias resistor should be 2000 ohms.

FILTERING

There is nothing wrong with the rest of the circuit except that, using typical components, the filtering is hardly likely to be adequate. Another section could be added to the filter, but, better still, the plate and screen supplies to the 6J5-G and 6J7-G could be de-coupled to advantage through a common 25,000 ohm resistor and bypassed to earth at the point of junction with an 8 mfd. electrolytic. Such de-coupling would not only reduce the hum level, but would most likely prevent trouble with any motorboating.

Go to it, then, L.G., and correct your circuit in accordance with our suggestions. Do not forget, incidentally, to earth the 6.3 volt heater circuit either by the centre tap or by one side.

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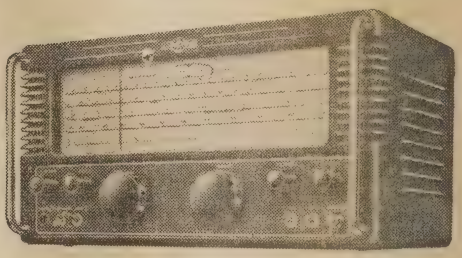

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PART 9—OSCILLATOR CIRCUITS

While the signal and R.F. circuits of a television receiver determine the signal-to-noise ratio, on the local oscillator depends its ability to stay in tune. Its design involves not only the choice of a suitable electrical circuit, but also the selection of a reliable mechanical system. Here then is the first of two articles on television oscillators.

OSCILLATOR stability is an important consideration in any superheterodyne receiver. On the broadcast band it has ceased to be a serious problem, mainly because long experience has evolved valves, components and techniques which give adequate results with the degree of selectivity normally employed.

However, the application of the same components and techniques at higher signal frequencies leads to trouble with oscillator drift and this is evident, even on standard dual-wave receivers. For the still higher frequencies demanded by a television service, a completely new approach is necessary.

In terms of physical construction, it becomes desirable to avoid or minimise the use of ordinary bakelite in valve bases and sockets, for coil formers, for condenser insulation—in fact, in any of the active portions of the oscillator circuit. Approved materials include mica-filled or other high-frequency bakelite, low-loss plastics or ceramics.

RIGIDITY

Mechanical rigidity is also important and this actually rules out some insulating materials which are electrically good but likely to warp or flow under heat and stress. All wiring must be rigid and any switching of the tuned circuits calls for the greatest care in design.

For chassis work, aluminium and sprayed steel are not a good choice, owing to the difficulty of maintaining good earth bonds for the electrical circuits. Copper is an excellent medium, although plated steel has the advantage of cheapness. Earth returns are best soldered direct to prepared spots on the chassis.

Silver plating, although expensive, is a further refinement and contributes to high frequency efficiency, especially when applied to coils and tuning condensers. Much of the UHF equipment which appeared near the end of the war used silver plating very freely to ensure the best possible results.

It is not unusual, in television receivers, to treat the oscillator section as a complete sub-assembly, which is then proofed against the worst effects of shock and temperature variation.

Even allowing for all these precautions, some frequency drift is likely to occur in a practical receiver, especially during the initial warming-up period. It can be partly compensated by the use of condensers in parallel with the tuned circuits which have a designed temperature coefficient. By carefully selecting the compensating condensers, their effect on frequency can be made partially to balance the inherent drift in the rest of the circuit.

Variations over and above this are often compensated by provision of a vernier tuning knob on the control panel.

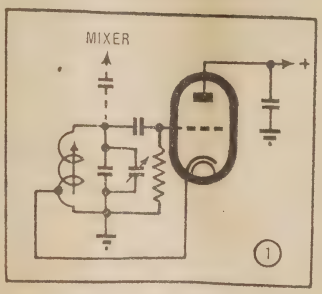
As stated in the previous article, conventional frequency changing valves are at a disadvantage at high signal frequencies, owing to their high noise factor and also the limited design of the oscillator section.

British television designers, catering for a fixed frequency service in the 50Mc region, have nevertheless used these valves with reasonable success.

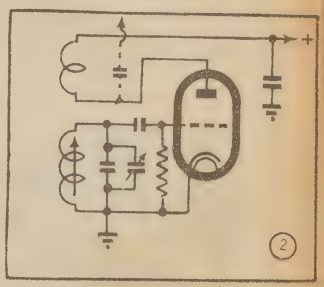
MINIATURE VALVES

The latest miniature frequency changers, like the 6BE6 and the 6AN7, are rated to operate up to 100 Mc, and this represents at the moment just about the top limit for this class of valve. For a television service operating at a substantially higher frequency, the use of a separate oscillator appears to be axiomatic.

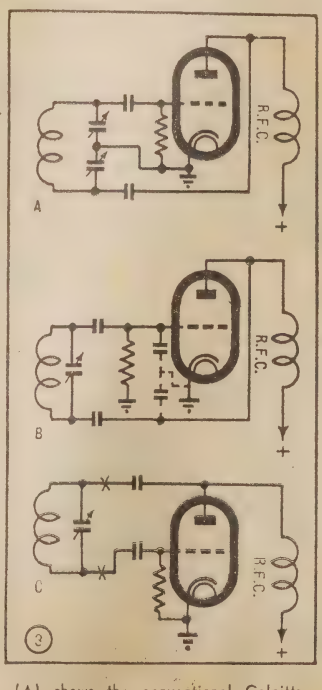
Of necessity, also, the oscillator valve must be of miniature construction, in which both the length of leads internally and the inter-electrode capacitance are reduced to



Conventional cathode tapped oscillator, suitable for fixed frequency receivers. A pentode gives better isolation between oscillator and signal circuits.



Another conventional oscillator circuit. The number of connections to the coil makes it unsuitable for other than a fixed frequency receiver.



(A) shows the conventional Colpitts oscillator and (B) its basic similarity to the ultraudion oscillator. (C) shows how it is normally drawn. Two connections only are required to the tuned circuit.

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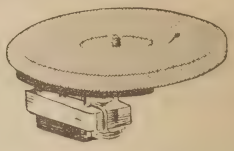

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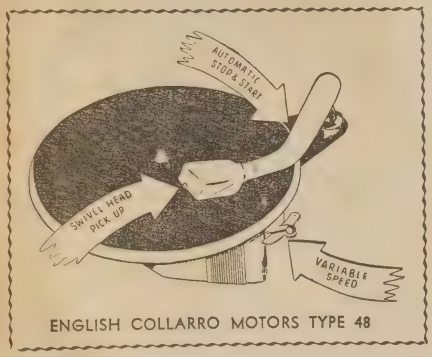

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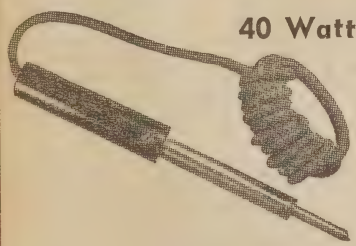

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a minimum. In conventional large valves these quantities are often such that they will not oscillate at the required frequencies, even assuming that the external L and C is reduced to the barest minimum.

In any case, in the interests of stability, it is also desirable to have as much of the tuned circuit as possible external to the valve, instead of being distributed along lengthy internal leads. Low L and C in the valve is especially important where provision must be made for channel switching—a requirement which inevitably adds stray components to the circuit.

On the broadcast band, it is usually necessary to arrange matters so that the rotor plates of the tuning condenser are at earth potential and this restricts somewhat the choice of oscillator circuit. In practice only two systems are widely used, the conventioal plate feedback arrangement using a double wound coil and the cathode tapped system.

T.V. RECEIVERS

Television receivers, on the other hand, are not bound to use gang condenser tuning. It is not necessary for a single channel system and it is unsatisfactory anywhere where wide frequency coverage is required. As a result, the designer is free to vary the oscillator circuit as he pleases in the interests of convenience and stability. Some of the circuit arrangements may therefore appear strange to anyone who is accustomed only to normal broadcast receivers. Others are quite straightforward.

Figures 1 and 2 are actually conventional arrangements, which might be found in any receiver. In the television field, their main application would be found in single-channel receivers, where the provision of a tapping in the one case, or two separate windings in the other, is no great disadvantage.

Although depicted as triodes, the oscillator valves could equally well be pentodes. In figure 1, particularly, the pentode scheme is attractive because it allows the screen to be bypassed and operate virtually as the anode of the oscillatory circuit. The actual plate can be provided with a small R.F. load and coupled to the mixer, thus providing the injection voltage and maintaining complete isolation between the tuned circuits.

FREQUENCY ADJUSTMENT

The oscillator frequency can be trimmed, naturally, by varying either the inductance or the capacitance, the former the most usual practice.

The coils can either be self-supporting or else wound on a low loss former, which carries, at one end, a threaded boss to support the adjusting slug. The use of an iron dust core is rare above 30 Mc. and the inductance is varied instead by introducing a silver-plated rod or cylinder into the coil. It reduces inductance progressively without interfering too much with circuit "Q" over the working range.

In an oscillator circuit, it is advantageous to keep the amount of capacitance relatively high and to concentrate the capacitance in a selected condenser, or condenser combination. In many cases the capacitance may designedly have a negative temperature coefficient to compensate the natural positive drift in the rest of the circuit.

The trimmer shown would normally be accessible to allow any further correction which might be necessary to the tuning. Such adjustment is usually necessary only to the oscillator, since the signal frequency circuits are likely to have sufficient bandpass to cover any normal change in their characteristics.

A small amount of coupling is necessary between the oscillator and mixer valves to allow the latter to function. In some cases, the stray coupling between leads and components is considered adequate, although it is likely to allow severe injection variations in production.

Alternatively, special care may be taken to avoid stray coupling and the injection arranged by deliberate capacitative coupling between the mixer grid and a suitable point on the oscillator circuit. The coupling capacitance required is usually quite small —something of the order of 5 pf.

Low impedance link coupling has also been employed, but is generally much less convenient than capacitative coupling.

"PULLING"

Whatever the method used, it should not introduce any more coupling than necessary between the signal and oscillator tuned circuits, in order to minimise "pulling" effects. The initial adjustment of a receiver is greatly complicated if every operation on the R.F. circuit changes the oscillator frequency.

When a receiver has to cover several television channels, which may extend from 50 to 200-odd Mc., the designer must display a good deal of ingenuity to produce a workable tuning system. The problem is simplified considerably if all superfluous connections and windings are obviated in favor of a two-terminal oscillator system—in other words a system which requires only two connections to the tuned circuit.

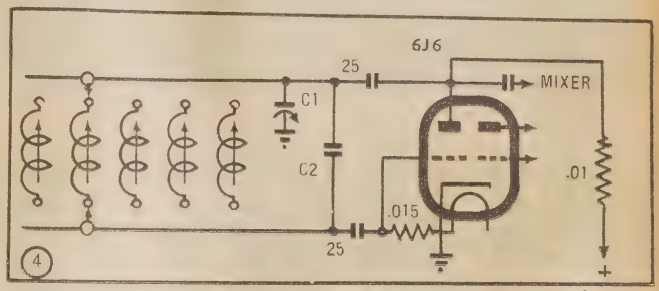
Various types of two-terminal oscillator have been devised, but the most popular one for television work appears to be the ultraudion circuit.

Actually, the ultraudion circuit is an adaptation of the better-known Colpitts oscillator and the similarity between them is illustrated by fig. 3.

Figure 3A shows the conventional Colpitts oscillator, in which the tuned circuit is virtually tapped by having the rotors of the two-gang tuning condensers earthed. The effect is much the same as if the coil were actually tapped and made "earthy" at somewhere near its centre point.

In 3B the two-section condenser has been replaced by a single section unit and, at first glance, the tuned circuit would appear no longer to be earthed. In point of fact, however, the valve and circuit capacitances from grid-cathode and plate-cathode maintain a virtual tapping point.

These incidental capacitances do not appear in a circuit drawing and it is normally shown as figure 3C—the ultraudion oscillator. The circuit lends itself to UHF channel switching, since complete tuned circuits can be introduced bodily between the two points marked "X."



A typical and complete television oscillator circuit, arranged for channel switching. C2 is the main tuning condenser and "L" is varied in each coil to achieve resonance.

The exact method of achieving resonance is a matter of choice and convenience. The tuning capacitance can be common to all channels, resonance adjustment being by a variable slug in the coils. Alternatively, each coil assembly may also have its own variable tuning condenser.

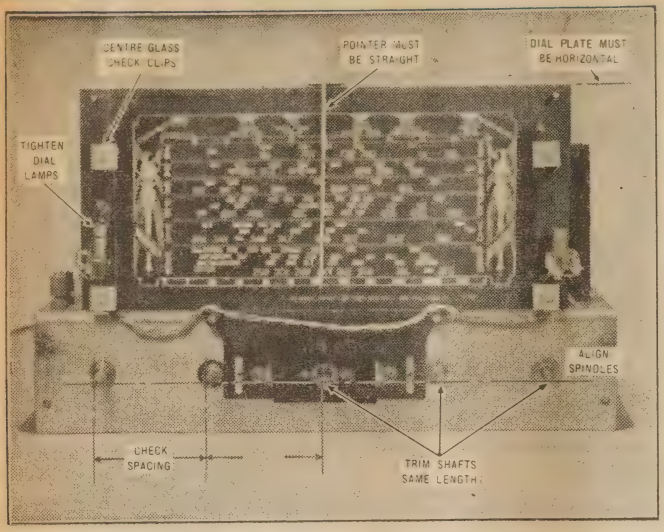
Figure 4 shows a typical form which a complete oscillator circuit may take, arranged for channel switching. All coils are provided with variable slugs for resonance adjustment. Normal practice would be to mount them in a turret or slide-bar arrangement so that the coils are brought in contact with the active terminals.

Condenser C2 provides the bulk of the tuning "C" and would normally have a negative temperature coefficient to compensate expected variations elsewhere in the circuit.

The effective tapping of the coil is provided by Cg-k on the one band and by Cp-k and C1 in parallel on the other. Condenser C1 is variable and allows orrection to be made for frequency drift not otherwise compensated. It would appear on the panel as a "vernier tune" control.

Various oscillator valves can be used in this class of circuit, although one half of a 6J6 is favored by many American designers at least. The remaining section is variously left floating, or used as the mixer or even employed to provide automatic frequency control.

(To be continued)



Various points, as illustrated above, must be checked before the chassis is fitted to the cabinet. Even slight mis-alignment of the controls is noticeable against the lines of the cabinet.

YOUR CHASSIS AND CABINET

A receiver can hardly be considered as complete until it is finally fitted up in its cabinet and installed as part and parcel of the home: In this article we discuss the choice of a cabinet, the method of fitting the chassis into it and, finally, the special problems which are involved in a radio-gramophone combination.

by W. N. Williams

AT the outset, one may legitimately ask . . . "Why have a cabinet? It it not better to mount the chassis near to hand and put the speaker in a proper baffle?" Technically it is, but there are still plenty of constructors who prefer, for one reason or another, to fit their set in a conventional cabinet.

It is for such folk that this article is written.

Small mantel cabinets are available ex-stock from most radio distributors, but larger consoles are a different story. They are more costly, more difficult to store, more easily damaged and, in some cases, in restricted supply. Despite this, however, large cabinets can be bought and you should be able to obtain satisfaction from one or other of the advertisers in Radio and Hobbies.

CHOICE

The choice of a cabinet is dictated first and foremost by its appearance and the way it will merge—or clash—with the rest of the furnishings. On this basis, its workmanship must be assessed in the same way as any other item of furniture—the fitting of the veneer, the surface and polish, the angles, corners, hinges and so on. After this, it can be considered on its merits as a radio cabinet.

Apart from housing the chassis and accoutrements, the main job of a cabinet is to provide a baffle for the loudspeaker and assist it in developing, in particular, a good bass response.

No ordinary open-backed cabinet is ideal as a baffle, because it is prone to resonance effects around 100 c/s and gives a falling bass response below that. Specialised treatment and damping may subsequently improve matters but a cabinet should be regarded initially as a baffle. As such, the larger the baffle area, the better. Buy the largest cabinet which your room—and your pocket—can accommodate.

Watch the thickness of the timber, however, since this will largely control the ruggedness of the cabinet. The best cabinets are made from 7/8 or 1-inch ply, which is unfortunately rather expensive and hard to obtain. Properly blocked and glued at the corners, such a cabinet can generally be relied upon to be free from rattles and resonance effects in the panels. It should not be distressed by the low frequency energy generated even by a big high fidelity speaker.

Cabinets made from lighter plywood—about ½-inch—are often used for commercial receivers. They are normally good enough for domestic purposes with an ordinary 12-inch speaker. Make sure, however, that the corners are firmly glued and blocked and that there is no tendency for the cabinet to rattle when bumped.

If the receiver is a radiogram, you will need a cabinet with place for a gramophone motor and pickup. It is desirable for the pickup to be housed beneath a lift-up lid to block off direct acoustic output.

The popular arrangement is to have both the pickup and the tuning controls under a single lid at the top of the cabinet. Chief drawback is that the lid must be left open if the set is in frequent use. If not, it is invariably necessary to lift off the eternal vase of flowers before the set can be used!

Two half-lids, one over the pickup and one over the radio, are more convenient from this point of view. Alternatively, the set is sometimes placed so that the dial and controls are accessible from the front of the cabinet, with only the pickup and turntable under the lift-up lid.

WATCH THESE

From the point of view of quality, beware of cabinet designs which put the pickup mechanism on a drawer or slide and crowd a necessarily small speaker into an odd corner. For good reproduction you really need a big speaker, as much baffle area as possible and a ready means to cover the pickup while it is actually playing.

So much for the preliminaries. To prepare the chassis for installation in the cabinet, trim the control shafts

down to the same length, making sure that they are at least long enough and directly at right angles to the face of the chassis.

Check with a straight-edge to see that they are in line horizontally and make sure also that the spacing between the spindles is equal or at least symmetrical. Correct any misalignment by removing the offending control and filing the mounting hole in the required direction. See that the dial is centrally placed with respect to the spindles and that the glass is exactly horizontal.

All these points should, of course, be attended to during the initial assembly but a double check before final fitting is well worthwhile.

THE ESCUTCHEON

Before proceeding further, hold the dial escutcheon temporarily in position and make a few rough measurements of its relationship to the controls and the bottom edge of the chassis. Measure also the approximate position of the shelf which carries the receiver in the cabinet.

Tilting the cabinet so that things will stay in place, lie the escutcheon and the knobs in the approximate positions they will occupy when the chassis is finally installed. Your measurements should allow this to be done within half an inch or so.

Note whether the positions give a balanced appearance on the cabinet panel. If they are obviously too low, it will be necessary to raise the shelf in the cabinet or, more easily, to fit a false platform for the chassis to rest on. Alternatively, you may choose to leave the knobs in the existing position and to raise the dial by mounting the gang condenser differently.

Whatever you do, don't start drilling holes until you are sure that the controls and dial will fall neatly into position. Twenty pounds worth of high-class cabinet can be entirely ruined by incorrect proportions.

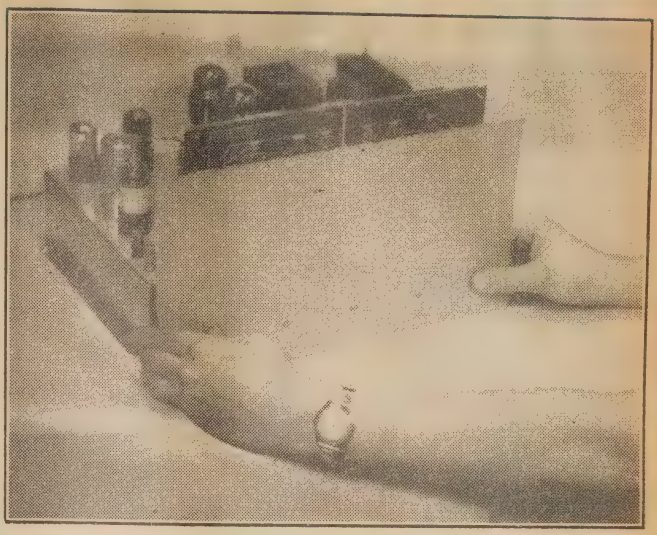
TEMPLATES

From this point onward there are several methods of attack. Our favorite scheme is to use a paper template to transfer the position of the controls to the face of the cabinet.

Set the chassis on a flat table and rest a piece of fairly stout paper on edge and against the tips of the control shafts. Press the paper with a finger against the tip of each shaft hard enough to leave a clear imprint. Pick out the centre of each indentation with a sharp spike.

Now take the paper template and mark the centre line, which will either be through a control spindle or centrally between two of them. Take the template and hold it against the inside face of the cabinet panel, with the reference edge resting on the shelf and the indentations facing forward. Use a rule to locate the centre line as close as possible to the centre of the cabinet.

Push the spike through the centre spindle hole on your template and into the panel, until the tip just begins to bulge the front veneer.



Taking a template of the control spindles. Make sure that the edge of the chassis and the edge of the paper are flat on the table-top.

Leave the spike in place and take a careful look at its position.

Many cabinets have veneered panels which meet and match on the centre line, and it is most important to make the centre knob and figuring on the escutcheon plate correspond with the line in the veneer. You will probably find that the spike has made its mark slightly to one side of the line or the other, and it is only a matter of shifting the template and the spike over by a fraction of an inch to put things right.

USE OF SPIKE

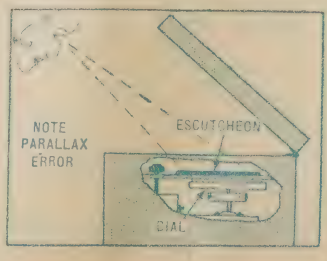
Where there is no centre spindle, it will be necessary to push the spike through the two adjacent positions and then make sure that the positions are spaced equally on either side of the veneer line.

This done, the spike can be pushed right through the veneer and the position of all spindle holes clearly marked.

To drill the holes, either a 3/8in centre bit or an auger bit are the best, although an ordinary twist drill can be used. You may be able to start from behind, but always drill the major portion of the hole from the front to avoid splintering the veneer.

Having drilled the holes, push the chassis into position and note how the spindles locate themselves. If you have worked accurately, they will all be central in the holes. If not, mark the holes appropriately and "lead" them one way or the other with a small rat-tail file. Work with the file deep in the hole, otherwise it may come out unexpectedly and score the veneer.

Having checked on the holes, remove the chassis and lie it on its back. Then put the escutcheon plate on the dial glass, centrally over the dial scale. Measure accurately the distance from the spindle line to the bottom edge of the escutcheon.

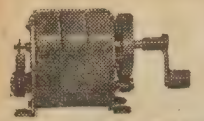


Paralax error makes it desirable to mount the escutcheon slightly above or below the dial markings in certain cabinet designs.

PARALAX

Before going further, consider the angle from which the dial will normally be viewed. With a sloping panel, the viewer will normally look directly into the dial. When mounted vertically, on the other hand, the dial is viewed from above and the escutcheon should be placed a trifle above centre, usually about 1-8in, to compensate for parallax error. When the dial is horizontal, on the other hand, it is viewed from beneath, so that the escutcheon can be lowered a trifle in relation to the dial scale.

Having decided this point, put the chassis back in the cabinet and locate the position of the escutcheon from the previous measurements. Have someone hold it in place while you mark around it carefully with the tip of a spike. Watch the corners in particular, which are generally rounded and with not too much over-



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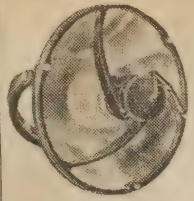

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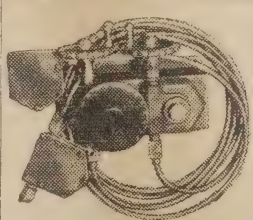

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Containing two Bowden control cables and 360 deg. slow motion dial. Ideal for car radios, etc. **£1/-/-**

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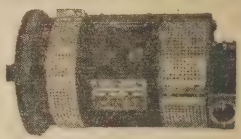
6" Permag. Without transformer, 15/-. With 1500 transformer, £1.

Postage and Packing: Vic., 1/6; N.S.W., S.A., Tas., 2/6; Qld., W.A., N.T., 3/6.



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All generators checked and tested before despatch.

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24 Volt 1500 Watt	12	10	0
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5¾in. dia. x 2¾in. deep, accurate Aircraft type navigational compass.

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TYPE R3109 H.F., I.F.F. RECEIVERS

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393 Flinders St., Melbourne. Phone MB2701.

MAIL ORDERS PROMPTLY DESPATCHED.

lap of bakelite to cover possible errors.

To cut the hole, you will need a small keyhole saw. Run the auger or centre-bit through each corner, and then go to work with the saw. Cut just inside, but up to the mark, ignoring any small extra cutouts required by the dial moulding. These can be accommodated later by using the rat-tail file and, by careful work, you should be able to make the escutcheon a fairly tight push-fit into the wooden panel.

This done, slip the chassis in place and inspect your handiwork.

If all is well, no further adjustments should be necessary, although it is generally possible to juggle things either way by judicious use of the file.

Before finally screwing the escutcheon in place—you will need four small screws for this—make sure that the glass is gripped firmly, assuming that there is a glass plate in the escutcheon.

Then push the chassis up against the escutcheon firmly, but not so hard that it endangers the dial or makes the movement stiff. Mark the position of the holes in the chassis flange where the locking-screws or bolts will ultimately go.

Next, slip the knobs on the spindles, push them home and note how much space there is between the skirt of the knob and the veneer. The chassis can then be removed, and this same amount trimmed off the spindles. The best way to do this is to have someone support the chassis while the tip of the spindle is gripped in the vice. It can then be sawn off without danger of wrecking the control itself.

Clean off the burrs, and your chassis is ready for final installation. Push it into place and screw it down. Put a small felt washer behind each knob and lock it in place. But watch that screwdriver—it can either slip into your hand, or, worse still, score the veneer!

If the dial plate tends to vibrate against the escutcheon, it can generally be pinned forward with a screw or a metal strap. Use a short screw, however, or you may subsequently find the tips protruding from the veneer.

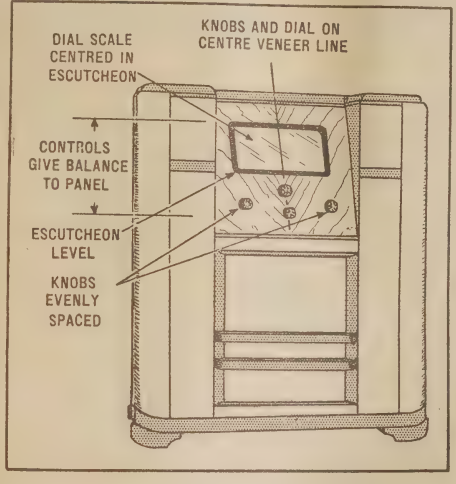
Fitting the speaker should not be a difficult job, provided that the baffle hole is of the correct size. This, by the way, is a point to watch when ordering the cabinet in the first place.

The diameter of the cutout should ideally match the inside rim of the cardboard surrounding the speaker cone. The baffle hole can actually be a half-inch or so smaller than this without harmful results, but that is about the limit. Anything smaller will necessitate removing the baffle from the cabinet and enlarging the hole with a keyhole saw.

If, by any chance, the hole is too large, the only alternative to cutting a complete new baffle is to obtain a rectangle of heavy ply large enough to cover the original hole and to mount the speaker on that.

Be sure to locate the speaker centrally over the hole, and there is a simple way to ensure this.

Having checked the diameters, drive from four to six panel pins lightly into the wood, symmetrically around the baffle hole and spaced out about an inch from the edge. Then hold the speaker centrally between them and screw it in place. Use heavy screws, but not so long that they will drive right through the baffle.


DIAL SCALE CENTRED IN ESCUTCHEON
KNOBS AND DIAL ON CENTRE VENEER LINE
CONTROLS GIVE BALANCE TO PANEL
ESCUTCHEON LEVEL
KNOBS EVENLY SPACED

Consider these points before you make any cut-outs in the cabinet. The whole appearance can be spoiled by a poor balance between the controls and the veneered panels.

Incidentally, a heavy speaker is often difficult to hold in place while the screws are driven home. Simply lay the cabinet on its face on a rug and you can relax. Position the speaker terminals or output transformer so that the connecting leads will reach up to the chassis. That is just about all there is to the fitting of a straightforward radio set.

With a radiogram there is the additional job of installing the motor and pickup.

If you buy a complete record-player unit, it is largely a matter of following the cutting template which is usually supplied. However, the whole unit has to be positioned to best advantage on the motor-board.

It is usually best to have the pick-up facing forward on the right-hand side of the turntable, where it can be handled conveniently with the right hand. The head is also close to hand for changing needles, &c.

See that the pickup in the "at rest" position is substantially parallel with the side of the cabinet, or putting things another way, avoid an odd and unsightly angle. The pickup

(Continued on Page 78)

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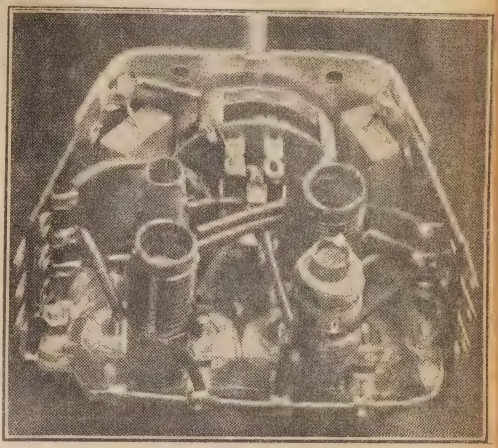
TRADE REVIEWS AND RELEASES

MINIATURE D/W BRACKET FROM R.W. STEANE

Latest product from R. W. Steane & Co., manufacturers of "Q-Plus" components, is a miniature dual-wave coil bracket. Probably the smallest of its kind to be released on the Australian market, the new bracket is ideal for small mantel dual-wave sets.



EXCLUDING the shaft, the overall dimensions are approximately 3¼ x 2¼ x 1¾ inches and the special triangular shape allows the volume control and dial spindle to be grouped quite close to the wavechange switch.

Despite the miniature size, the manufacturers claim that the performance is unimpaired. The broadcast coils are wound with selected litz wire and all coils have variable slugs made from Carbonyl spherical-particle iron dust, imported from the US.

Said to be a German wartime development, the use of this special type of powder can contribute to the "Q" factor of short-wave coils, instead of introducing actual loss, as many powders do. Thus, it is claimed, the facility of variable inductance can be combined with a high "Q" in small short-wave coils.

The trimmers are mica compression types mounted on a single polystyrene bank. Padder condensers are built in and terminal strips at the extreme rear provide for ready access to the associated circuits. The unit is tropic proofed, making it suitable for use in tropical areas.

The circuits are pre-aligned at the factory before packing but instructions are supplied for further alignment to cover the possible effects of installation in a chassis. The wiring code is printed on the carton.

Coil brackets are available to suit all the better-known converters and the manufacturers stress the importance of obtaining the correct unit for each particular class of receiver. In this way unsatisfactory performance will be avoided.

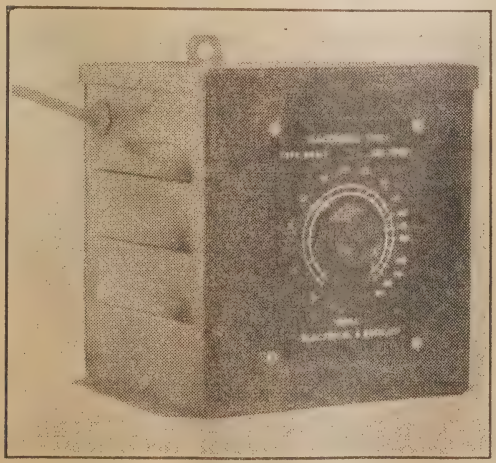
On the broadcast band, the coverage with a standard 2-gang is from 540 to 1640 Mc., and on the short-waves, from 5.9 to 18.2 Mc.

Retail price of the unit is 49/6 and supplies are available on demand from the company's distributors throughout Australia.

A NEW ELECTRONIC TIMER

For controlling processes requiring a definite time cycle, the Nova Electrical & Engineering Co., have recently released the electronic timer pictured below. Various models cover time intervals from 0.1 sec. to 10 minutes.

ELECTRONIC timers are widely used in photographic darkrooms but they have many other possible applications—controlling spot welders, die casting, moulding, &c.



The "Nova" electronic timer is housed in a compact metal box and carries the time scale engraved directly on the title plate. The ranges are as follow:—Type 501, 0.1 to 20 seconds. Type 502, 2 to 60 seconds. Type 503, 5 to 300 seconds. Type 504, 10 to 600 seconds. All these sell for £13/10/-.

A more complex model, type 521, has five separate ranges, giving an interval selection of from .05 seconds to 20 minutes. Price is £24/5/-.

For reversed plating operations, the double timer type 1001 is available.

All the above are fitted as standard with a 240V. 5A. relay. Extra relays can be fitted if required and special types can be provided (Nova Electrical and Engineering Co., 311 Sussex Street, Sydney. Phone MA1786.)

BOOK REVIEW

IN THE WORKSHOP, Vol. I, by "Duplex," published in London (1949), by Percival Marshall and Co. Ltd. Hard cover, 186 pages. Australian price 16/- approx., plus 6d postage. Stocks are expected shortly.

Reader response to a series of articles in the journal "Model Engineer" led to their being reprinted in book form and under the same title. Further companion volumes are envisaged as the series continue.

This first volume devotes more than half the available space to lathe work, typical chapter headings being "Lathe Chucks," "Tool Equipment for the Lathe," "Knurling," &c.

Later chapters deal with the "M.E." drill machine, flat surfaces, scraping and the surface gauge.

The text is clearly illustrated by line drawings throughout and the presentation is calculated to interest and assist both the student and the hobbyist who is fortunate enough to possess workshop facilities of this order.

EXCEL KITSETS

RADIO BENDIX MN.26.C COMPASS RECEIVERS

Huge Purchase, 500 Brand New in Original Cases.

THE LAST OF THESE RECEIVERS THAT COST £286/-/-

The saving in cost on this purchase passed on to YOU. This is the finest broadcast receiver ever offered 12 valve. Operates from 24V converts easily to 240V-AC also to 6V. 12V. OR.32V.

Completely converted, including Speaker, Dial and Control Panel, fitted tested and Dial calibrated ready to use.

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12V. D.C. Operation .. £22/17/6
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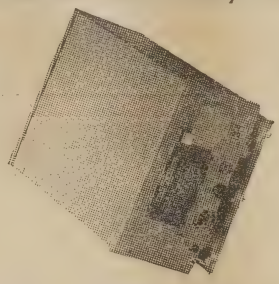
110V. A.C. Operation £20/17/6
240V. A.C. £20/17/6



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Valves and 12" Speaker
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Designed To Operate Pickup

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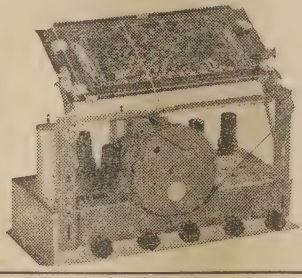

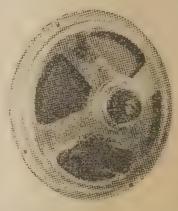

PHONE: LA1604

EXCELAIR RADIO

136 VICTORIA ROAD, MARRICKVILLE.

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BOOK REVIEW

"SOUND REPRODUCTION," by G. A. Briggs. First edition, July, 1949. Published by Wharfdale Wireless Works, 143 pp. and hard covers. Australian price, 10/- (approx.), postage 6d.

This new book "Sound Reproduction" is largely the sequel to an earlier and smaller book by the same author "Loudspeakers—The Why And How Of Good Reproduction."

The opening chapter deals with sealed and vented speaker enclosures and the author's approach has been to build and test a variety of cabinet shapes rather than simply to restate now well-known theory. This approach has revealed the significance of compliance in wooden enclosures, the effect of internal shelves and pipes and also of cabinet shape.

Some of his conclusions challenge accepted theory, others recall reservations and opinions which have been expressed in "Radio & Hobbies" articles from time to time.

The centre section of the book deals with specialised aspects of sound reproduction while the final chapters cover sound recording and reproduction.

The text is just the right "weight" for amplifier enthusiasts, a happy compromise between the practical and theoretical approach. Our copy from McGills Agency, Melbourne.

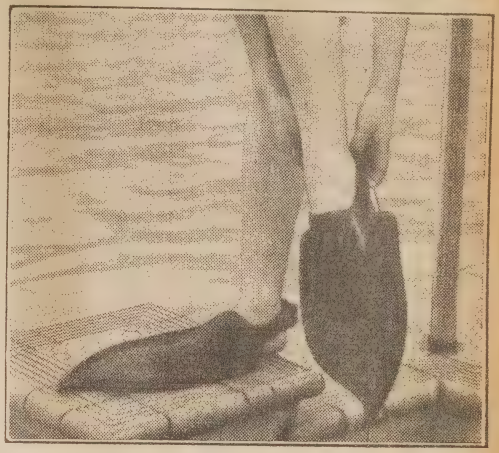
SWIM FASTER WITH RUBBER FINS

Messrs. Surplus Stores, of 512 Elizabeth Street, Melbourne have good stocks of rubber swimming fins, as supplied to commandos and "frogmen" during the war. They are said to increase swimming speed by as much as 40 per cent.

AS illustrated on the right, the fins have recesses for the foot and are held in place by a stout strap which passes around the heel. They are thus readily attached but are not likely to come adrift in the water.

By employing a kicking action, their special shape gives vastly increased drive from the feet and makes it quite possible for a swimmer to cover 50 yards in about 20 seconds.

Alternatively, after a little practice, the swimmer may be able to cover much greater distances than normal by allowing the legs to do a greater share of the work.



The fins are available from Surplus Stores at £3/7/6 per pair, freight or postage extra. Mail orders should mention the State in addition to the normal postal address.

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PRICE'S RADIO 1950 BUYERS GUIDE

PAGE ONE

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Q-Plus Loop Aerials, 5" x 4", with high impedance primary	7 6
Bakelite Aerial Insulators, 4" long, with metal loops	0 6
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R.C.S. Cotton Honeycomb	1 6
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125 m/A.	22 0
150 m/A.	25 0
200 m/A.	36 6
Ferguson—	
CF100. 50H. 10 mA.	18 0
CF101. 30H. 25 mA.	18 0
CF102. 15H. 60 mA.	12 0
CF103. 30H. 60 mA.	26 0
CF104. 30H. 75 mA.	31 0
CF105. 15H. 80 mA.	24 0
CF106. 12H. 100 mA.	24 8
CF107. 30H. 100 mA.	34 8
CF108. 12H. 150 mA.	35 0
CF109. 20H 150 mA.	37 8
CF110. 12H. 200 mA.	43 8
CF111. 16H. 200 mA.	45 10
CF112. 10H. 250 mA.	46 2
R.C.S.—	
TC66. 20H. 60 mA.	18 6
TC65. 30H. 50 mA.	13 6
TC60. 30H. 100 mA.	13 6
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Focus	Selectivity
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Intensity	Tone
Key	Transmit
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CF101. HT. 25 mA	18 0
CF103. HT. 60 mA.	26 0
R.C.S. RF106. LT. RF Choke.	4 3
Henderson. LT Filter	11 4
HT Filter	12 6

COIL FORMERS

Marquis Ribbed Bakelite, plug-in type, 1¼" dia. Available in 4, 5 and 6 pin	2 6
R.C.S. Polystyrene plug-in type. 6 pin. 1¼" dia.	3 3
6 pin. 1¼" dia.	3 5
R.C.S. Polystyrene Former. 2⅜" long x 1¼" dia	1 3
2⅜" long x 1¼" dia	1 5
Jabel Grooved Polystyrene Former, ¾" dia.	0 9
Jabel Mounting Bobbins	0 2
Jabel Mounting Base	0 6
Iron Dust Slugs for above	0 6
R.C.S. Low Loss Coil Lacquqer	2 6

KIT SETS

Complete kits of best quality parts can be supplied for all popular sets that have been described in local magazines. The following are a few from Radio and Hobbies.

Carry Set Portable	£12 19 6
Slumber Set	£9 19 6
Kar Set	£21 0 0
Radiogram Eight	£31 5 0

Please write for quotation on any kit that is of interest.

METERS, ETC.

Build your own Multimeter and save pounds.

Palec. 0/1 mA. meter, 3" dia...	59 7
Palec. 0/1 mA. meter. 4" square	68 3
Multipliyers. 1% accuracy for 5, 10, 25, 50, 100, 250, or 500 volts	2 0
Shunts. 1% accuracy for 10, 50, 100, 250 or 500 mA	3 0
Meter Rectifiers for AC volts	32 0

All types of meters available to order.

RECORDERS, ETC.

B.R.S. Home Recorder and Playback Unit is a professional type at a reasonable price, 78 RPM.	£45 17 6
Twin speed at 78 & 33 RPM	£51 14 6
B.R.S. Recording Blanks. 8" dia.	5 2
10" dia.	6 6
12" dia.	8 6
B.R.S. Recording Stylus	7 6
B.R.S. Discol Hardening Fluid	4 0

LOMOND ONE VALVE KIT

The most efficient one valve kit at present available. All parts are supplied including a drilled panel and chassis, batteries, phones and full, easy to follow instructions.

£5/-/-

KNOBS

Brown Bakelite Knobs in nine fancy designs. Small	0 8
Medium	0 9
Large	0 10
Q-Plus Flush Knobs Colored	1 3
Black Pointer Knobs Small	0 9
Large	1 0
English Black Instrument Knobs. ⅜" Dia.	1 0
1" Dia.	1 3
1½" Dia.	1 6
2" Dia.	1 9

THIS IS THE FIRST OF A SERIES OF BUYERS GUIDES, AND FURTHER PAGES ARE TO APPEAR IN RADIO & HOBBIES FOR MARCH & APRIL.

We endeavour to carry every article listed in stock, but circumstances beyond our control make this difficult, and there may be some delay in the despatch of a few items.

PRICE'S RADIO

5 & 6 Angel Place
SYDNEY

PRICE'S RADIO 1950 BUYERS GUIDE

PAGE TWO

VALVES

Space will not permit a complete list of valves that are normally available. Please write if the type required is not listed.

1A7GT	21 3	6C6	18 6
1C7G	19 6	6D6	18 6
1H5GT	20 0	6F6G	17 3
1J6G	16 9	6H6GT	15 3
1K5G	11 3	6J7G	18 9
1K7G	20 3	6SA6GT	19 0
1L5G	18 3	6SJ7GT	18 9
1M5G	19 6	6SK7GT	18 6
1P5GT	20 9	6SN7GT	21 0
1Q5GT	20 9	6U7G	18 0
1R5	19 0	6V6GT	17 9
1S5	19 0	6X4	15 0
1T4	19 0	6X5GT	15 0
2A5	17 9	19	19 6
3S4	19 0	30	17 3
3V4	19 0	42	17 0
5R4GT	26 0	45	16 6
5V4G	18 9	57	17 3
5Y3GT	14 0	58	17 3
6A7	18 9	75	17 3
6A8G	18 3	80	14 3
6AU6	18 9	807	15 3
6AV6	17 6	KT61	17 9
6B6G	17 6	X61M	21 6
6B7S	18 9	EBF35	18 9
6B8G	18 9	ECH33	21 9
6BA6	18 3	EL33A	17 9
6BE6	18 9	884	32 0

SPEAKERS

All speakers are quoted with transformer. They can be supplied less transformer if desired.

Rola. Model 3C. 3" dia.	
E transformer	24 2
G transformer	26 0
Rola. Model 5C. 5" dia.	
E transformer	26 4
G transformer	27 10
D transformer	29 0
Rola. Model 6H. 6" dia.	35 2
Rola. Model 8K. 8" dia.	38 11
Rola. Model 8M. 8" dia.	46 3
Rola. Model 120. 12' dia.	71 6
Magnavox. Model 6P2. 6" dia.	38 5
Magnavox. Model 8P2. 8" dia.	40 7
Magnavox. Model 10P2. 10" dia.	52 5
Magnavox. Model 12P2. 12" dia.	56 1
Amplion. Model 5P8 5" Permag.	39 10
Amplion. Model 7P14 7" Permag.	52 6
Amplion. Model 5E7A 5" Electro	42 5
Amplion. Model 7E12 7" Electro	52 6

HARTLEY TURNER SPEAKER

If you desire the best quality of reproduction, the Hartley Turner speaker should be your choice. A 10" type is the only size manufactured as this firm specialise in the production of one really good model only.

£18/18/-

TOOLS

Drill your own chassis with a "Power" hole cutter. Adjustable from 1" to 2¾"	16 7
Spare Cutters for above	3 0
Kempthorne 4" Bench Grinder	35 0
Zefa Sprayer. For touch-up work, etc.	24 6
Birko. 40 Watt Solder Irons	20 6
60 Watt Solder Irons	21 9
80 Watt Solder Irons	25 6
Icon. 6 Volt Solder Irons	27 6

CHASSIS

Drilled steel chasis are available for all popular designs Special types can be made to order

Little General	7 9
Williamson Amplifier	12 6
3 Valve Super Tuner	10 6
T.R.F. Tuner	9 6
Minivox	7 9
Senior Radiogram	16 0
4/5 Advance	10 6
6/7 Standard	12 3
Fireside Five	12 0
4 Valve Amplifier	9 6
6 Valve Amplifier	12 3
2JU Transmitter (3 Chassis)	32 6
Oscillator Case and Chassis	32 0
1K5/4 Valve	10 6
Senior Portable	10 6
Power Supply	9 6
Kar Set (Brocaded)	35 0
Carry Set	7 9

CRYSTAL SET PARTS

Coils for standard type circuit	4 0
Ebro Enclosed Detectors	3 9
Red Diamond. Semi-Fixed Detector	7 6
Red Diamond. Refills	3 9
Tested Crystals	0 9

AC/DC MULTIMETER

Something outstanding in Multimeter values. A complete AC/DC type with the following ranges:— 10, 50, 250, 500 & 1000 volts AC/DC. 1, 5, 50, 500 mA. 0-5000 & 0-500,000 ohms.

£7/-/-

DIALS

Utility Micro Dials Ideal for Test Equipment and Short Wave Receivers	18 6
Philips Log Dial. For Short Wave Receivers. Can be calibrated	22 6
R.C.S. DA7 Kit Dial Scale is 3" x 3"	12 0
EFCO DIALS.	
USL37G. DW or BC, Scale, 5" x 2"	20 0
CD17. 0-100, Scale 3" x 3"	15 0
CD17. DW or BC, Scale, 3" x 3"	16 0
FD32. 0-100, Scale, 7" x 4"	19 6
FD32. DW or BC, Scale, 7" x 4"	18 6
MK17. Kit Dial. Scale, 3" x 3"	10 0
USL32. DW or BC Scale 7" x 4"	23 0
USL44. DW or BC, Scale, 5¼" x 3¼"	22 0
CD/36. DW, Scale, 8" x 8"	23 6
SLV45. DW or BC, Scale, 3¼" x 5¼"	22 6
USL46. DW, Scale, 9¼" x 4¼"	32 0
DP47. Dial Plate and Knobs	4 6
MSL48 Auto Dial	19 0
Replacement celluloid and glass scales can be supplied for all Efco dials.	
Eddystone—	
598 Full Vision	38 4
594 Vernier 3½" Black	32 6
637 Vernier 3½" Silver	36 10
597 Vernier 2" Black	25 9
639 Vernier 2" Silver	32 6
595 Direct 2" Black	8 0
638 Direct 2" Silver	10 4

GRAMO NEEDLES

HMV or Columbia Steel Needles in Soft, Medium or Loud. Per tin	1 10
Silent Stylus. Miniatures	4 3
Duragold	2 3
A.R.C. Sapphire, Standard or Coronet	16 6
Ferrocart Sapphire Straight, Trailer or Miniature	9 9

LINE FILTERS

Improve reception by installing an R.C.S. Line Filter. Electrical disturbances that reach your set via the power mains cause annoying crackles. The line filter will eliminate or minimise them.

27/-

RADIOMAC SCALES

Type A. 2½" dia Black with Brass markings Graduated 0-100 through 180 degrees	1 6
Type B. 2" dia. Black with Brass markings Graduated 0-100 through 180 degrees	1 0
Type C. 2½" x 1 5-8" Black with NP markings. Graduated 0-10 through 270 degrees	1 0
Type D. 1¾" x 1¼" Black with NP markings. Graduated 0-100 through 180 degree	1 0
Type E. 1¾" x 1¼" Black with NP markings. Graduated 0-10 through 270 degrees	1 0

PICK-UPS

H.M.V. "14" Lightweight Magnetic, moulded bakelite arm and rest, with Transformer	£4 19 6
H.M.V. "12" Lightweight Magnetic, metal arm, with Transformer	£8 7 3
Goldring "121" Lightweight Magnetic with Sapphire	£3 13 10
Goldring Replacement Head for Garrard Units, with Sapphire	£2 15 9
Goldring "Headmaster" with 3 Cartridges, Transformer and Tonaliser	£10 14 6
Ferrocart Crystal type	£2 9 6
Acos. GP6. Magnetic type	£2 4 1
Acos. GP10. Crystal type	£2 8 6
Acos. GP12. High fidelity Crystal type	£3 19 6
Acos. GP9. Unbreakable Crystal Cartridge	£1 2 1
Bakelite Needle Cups Per pr.	1 9

VOLUME CONTROLS

I.R.C. Carbon Potentiometers, .05, .1, .25, .5 and 1 meg.	5 0
With switch	9 6
Aerostat Carbon Potentiometers, .025, .05, .1, .25, .5 and 1 meg.	4 4
With switch	9 6
R.C.S. Wire Wound Potentiometers, 2500, 5000 & 10000 ohms.	7 6

VOLTAGE DIVIDERS

R.C.S. 15000 or 25000 ohms.	5 6

All prices quoted are nett, plus postage or freight and are subject to change without notice.
Goods may be despatched C.O.D. post within the Commonwealth, or Freight on by rail within N.S.W.

PRICE'S RADIO

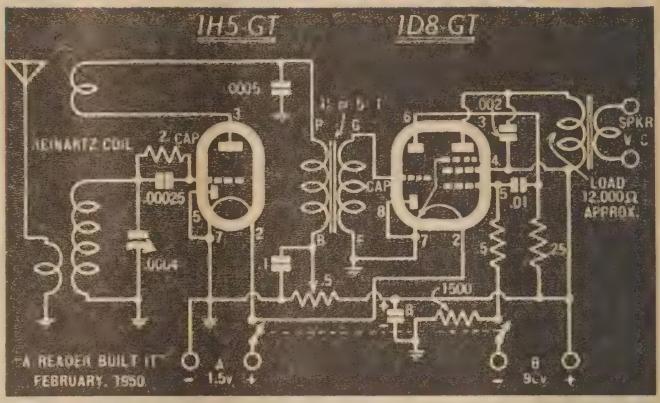
5 & 6 Angel Place
SYDNEY

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

WHY NOT TRY THESE SIMPLE TWO-VALVE CIRCUITS?

Maybe you are one of those experimenters who like to build small sets just to "try them out." These two two-valve circuits may provide food for thought, an incentive to build, or something.



THE first circuit is apparently the "pet" of Mr. A. G. Loveday, of Elimbah, Queensland. Our correspondent says in his letter, and we quote: " . . . this set should prove useful for the country enthusiasts who require a good cheap TRF broadcast receiver. The range of the set amazed me, considering the HT used. I have, to date, identified 18 local and interstate stations with 3AW being the furthest south.

"The HT can be provided by either one 6-volt accumulator or four No. 6 dry cells. As far as operating costs are concerned, the accumulator is the cheaper, as the No. 6 cells will operate for only approximately 12 hours on continuous operation.

TUNING COIL

"The coil used has 100 turns of about 32 SWG enamelled wire wound on a 1½in former, and with a tapping at 25 turns from the earth end. The set is very sensitive, and I would safely say that the range, with phones, would be about 500 miles.

"The regeneration control is handled in the usual way. If a 0.01 meg. carbon potentiometer is not handy for the job, a 0.05 meg. size would do. The chassis dimensions are 7½in by 5in, with a front panel of 5in by 6in."

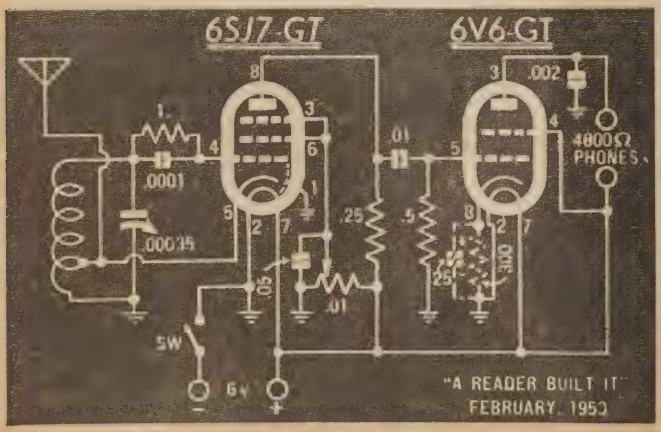
Mr. Loveday, we note, has provided a bias resistor and bypass in the cathode of the 6V6-GT. The need for these components is debateable, since, for the amount of current passing through the 6V6-GT, the bias developed would be very small indeed. You can please yourself about this or, better still, try the circuit both ways.

Valve types are not, of course, restricted to those shown. Almost any 6-volt heater RF amplifier and output types would do. Any RF component in the plate circuit of the detector will appear at the plate of the output valve, but the .002 mfd. capacitor should bypass this across the phones. It is usual in this detector circuit to bypass the plate straight to earth, with a condensor of about 250 pF.

The second circuit comes from Mr. A. E. Jobin, of 7 Tower Street, Hawthorne, E3, Melbourne, Victoria. Mr. Jobin built this little receiver several years ago, and he states that it has given excellent service ever since.

The coil is a standard Reinartz type mounted in an octal valve base. This provides the "plug-in" feature, so that the coil can be changed for short-wave reception.

Says Mr. Jobin: " . . . at night the short-wave reception is excellent and can be heard clearly through a 3in permag. speaker. On the broadcast band, the reception is also very good, some interstate stations coming in without any trouble at all."

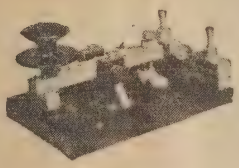


GRID BIAS

Our correspondent did not show very clearly the bias for the 1D8-GT, pentode portion, but we have inserted a back-bias resistor between B-minus and the chassis with the 0.5 meg. grid resistor returning to B-minus. The A-minus lead should, of course, connect direct to the chassis.

Increasing the value of the back-bias resistor above 1500 ohms will decrease the B-battery drain, but give somewhat reduced power output from the speaker. It's for you to decide upon your own compromise in this direction. What's best for the pocket may not suit the ear, or vice versa!

BARGAINS IN RADIO PARTS



MORSE KEY

Available in the following types,

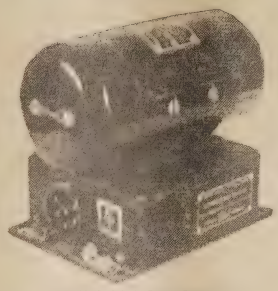
ADMIRALTY Type.
An extremely robust key mounted on bakelite base, all metal parts cadmium plated.
A lifetime job for the enthusiast or the amateur. Pre-war price of this key was 35/-.
Our price **5/-.**

ARMY Type.
A lightweight key for portable equipment. Easily worth 25/-.
Our Price **5/-.**

AIRCRAFT Type.
This key is flameproof and is standard equipment in most aircraft.
Worth 37/6.
Our Price **7/6.**

AERIAL TUNING UNIT

Employs coil 3" diameter. Consisting of approx. 10-gauge silver-plated copper wire with 2 sliding contacts both with Vernier Drive and counter. Can be adapted to suit almost any frequency.
Easily worth 25/-.
Our Price **5/-.**



GENEMOTORS

We have a few of the following genemotors in good order:—
Genemotor Type P.S. 225. Input 28 volts. Output 375 volts at 150 m.a.
Price **£2/10/-.**
Genemotor for SCR. 522. Input 28 volts. Output 300 volts at 260 m.a. 150 volts at 10 m.a. 14.5 volts at 5 amps
These are housed in black crackle finished steel boxes and have a filter with a cooling fan enclosed. An excellent job for heavy duty amplifier work.
Price only **£3/19/6.**

HEAD PHONE SETS

Dynamic Head Phone Sets with lead, in excellent condition. These sets are easily worth £4 per set. Our special price is only .. **15/-**
Transformers to suit headphones .. .. **4/6** each.
Transformers to suit microphones .. .. **4/6** each.

PLEASE NOTE!
ALL PARCELS WILL BE SENT REGISTERED POST UNLESS OTHERWISE STATED. POSTAGE MUST BE INCLUDED WITH ORDER.

SWITCH PANELS

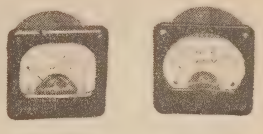
For Curtis Electric Air Screws. Each panel contains:

2 70 amp. Two-way toggle switches.

2 70 amp Automatic Overload switches.

2 4 - Position selector toggle switches.

All mounted on bakelite panel.
Price only **12/6.**



METERS . . .

We have acquired the following stock of meters. All these meters are imported and made by famous makers such as Ferranti etc. They are the square type 2" scale meters.

0-50 m.a. D.C. **22/6**

0-150 m.a. D.C. **22/6**

0-100 Volts A.C. Each one of the A.C. meters has a Westinghouse M.A. full-wave dry metal rectifier attached.
A real bargain at **39/6.**

MOTOR SPARES LTD.

547 ELIZABETH ST. MELBOURNE.

The Aegis METROPOLIS "4" was always a WINNER

NOW it's even BETTER!

Your favourite Aegis 4 valve Broadcast Kit assembly has been rejuvenated! In appearance, simplicity and in price the Aegis' Metropolis "4" is today's sensational news! Attractive new features include:—

IMPROVED APPEARANCE

The original Plastic Cabinet has been redesigned along more modern lines. Vastly improved in appearance, and more durable than ever before.

IMPROVED CIRCUIT

The main improvement here is the inclusion of the new Radiotron series of Valves: X61M, 6AR7GT, KT61, 5Y3GT Rectifier.

IMPROVED PERFORMANCE

By the inclusion of these new Radiotron Valves, the sensitivity is increased tremendously, and the usual Aegis high standard quality I.F.'s, Coils, etc, make the Metropolis "4" a true winner in Mantel Kit Sets today.

PRICE: Including Tax **£10/2/6**

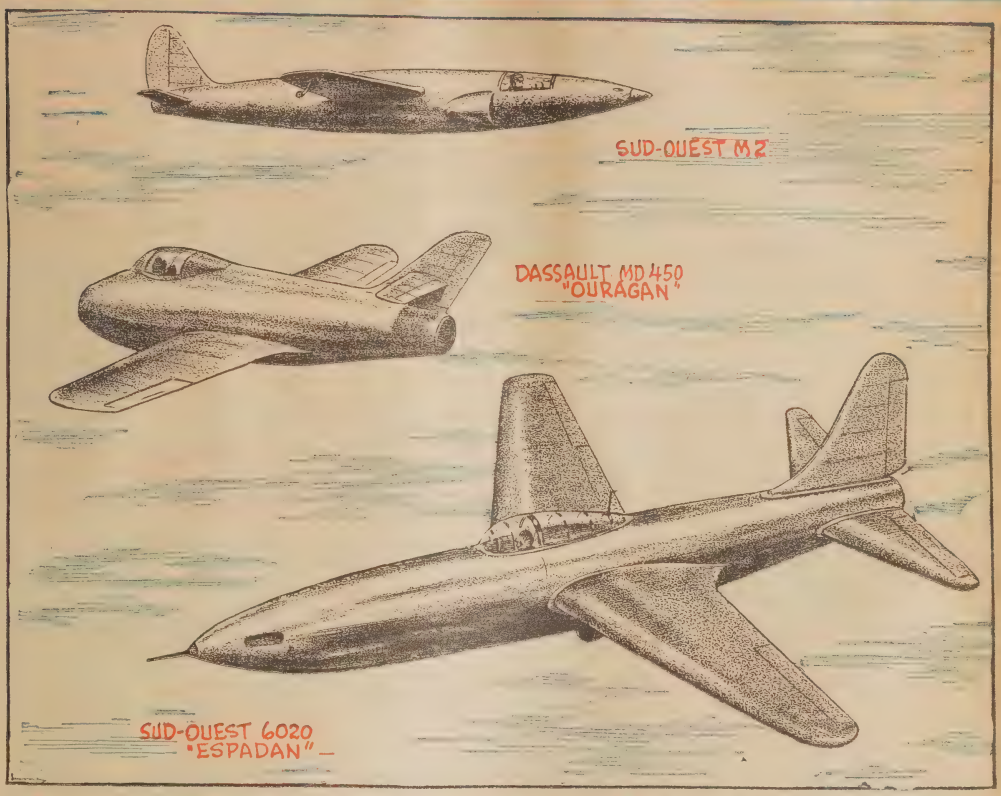
VALVES EXTRA

AEGIS MANUFACTURING COMPANY PTY LTD

208 Lit. Lonsdale St., MELBOURNE

— Distributors in Every State —

NEW FRENCH JET DRIVEN AIRCRAFT



For many years French aircraft development was halted, but a revival has been noticeable for some time, and great strides are being made. Aircraft now being turned out from French factories not only demonstrate ingenuity but are of high technical quality.

AMONG interesting new jet designs are the three single-seaters sketched here.

The M2, produced by the Societe Nationale de Constructions Aeronautiques de Sud-Ouest, is one of a series of jet-propelled aircraft produced for research into fighter design.

Its bullet-shaped fuselage is fitted with a retracting undercarriage consisting of three tandem wheels which are drawn into the centre of the fuselage base. A skid is fitted to each wing in the outer panel.

The M2 has a retractable windscreen which, when lowered (as shown), fairs completely into the fuselage line.

The aircraft is powered by a Rolls-Royce Derwent V centrifugal-flow jet unit.

Span is 29ft 9in and length 32ft 4in. Wing area is 190 sq ft.

A low-midwing monoplane, the Marcel Dassault MD450 fighter "Ouragan" (centre left) is on order for the French Air Ministry. It was designed and built in record time, and is highly regarded.

DESIGN FEATURES

The design features a swept-back fin and rudder, with the tail-plane placed halfway up the fin.

Twin air intakes lead round the pilot's cockpit to the Rolls-Royce "Nene" centrifugal-flow gas turbine built under licence in France by the Hispano-Suiza Co.

Top speed of the "Ouragan" is said to be over 600 miles an hour.

The Sud-Ouest 6020 "Espadan" (lower right) is a long-range fighter that must be classed as quite a notable interceptor.

It is powerfully armed, mounting six heavy machine-guns.

The design is characterised by the long, sharp-pointed nose and slightly back-swept wings.

The pilot's cockpit is placed well forward, being in front of the leading edge of the wings.

A ventral scoop supplies air to the Hispano-built Nene turbo jet mounted in the rear centre section of the fuselage. A conventional single-fin tail unit is fitted.

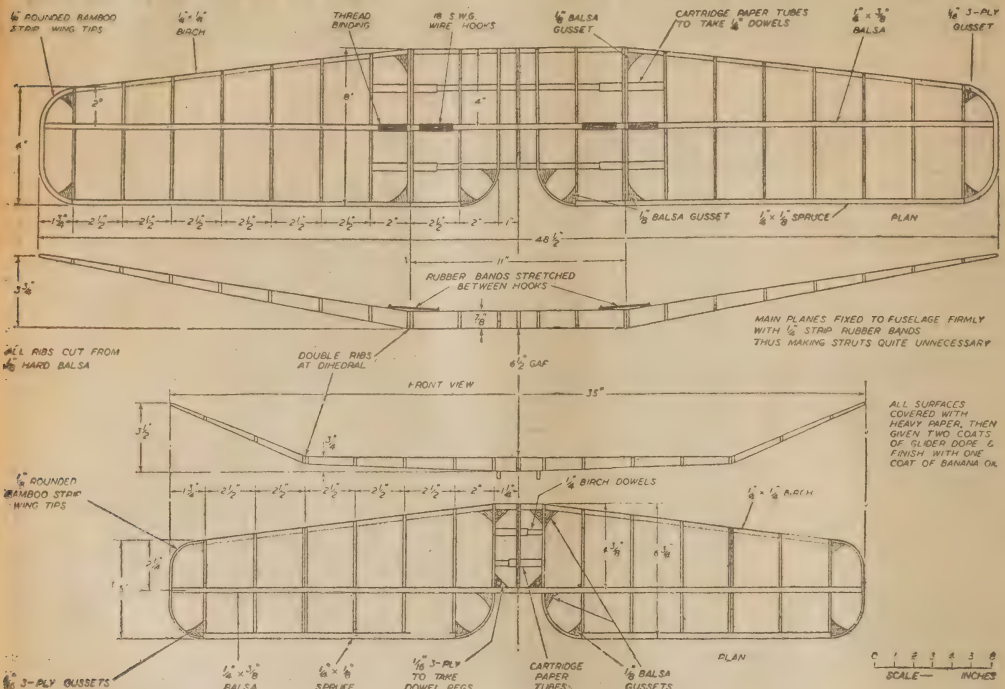
Electronic Thought

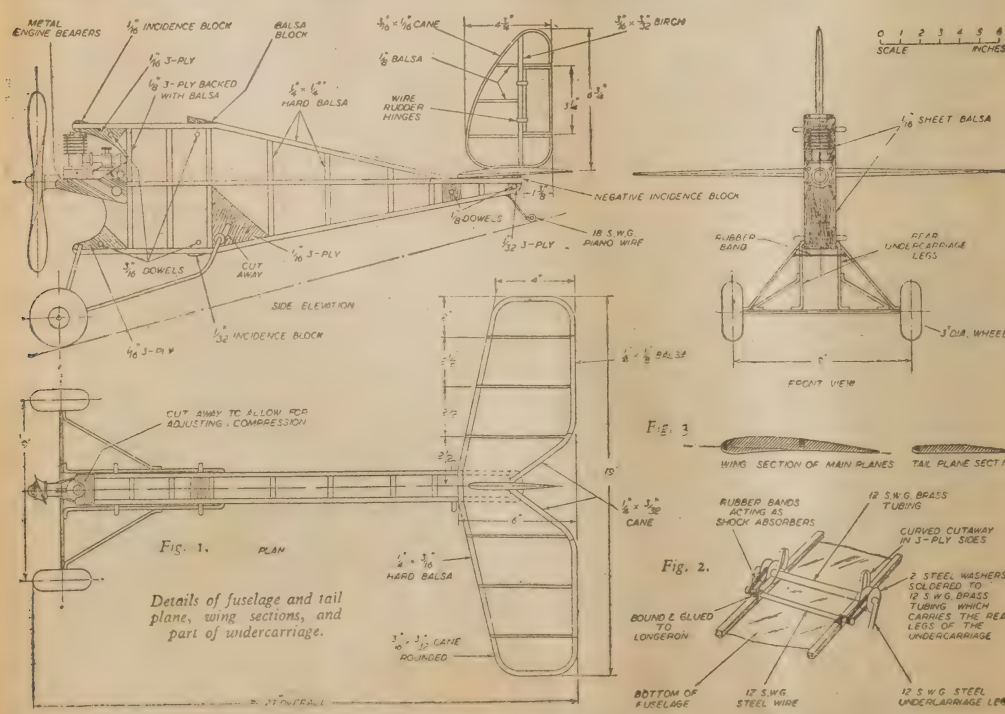
COMPUTING machines, popularly known as electronic brains, have to be told what to think.

Building a giant electronic machine doesn't end the work of the busy mathematician,

The machines, though highly accurate in doing grade school arithmetic and as fast as an electron in operation, are very stupid when it comes to knowing what to do next. Before the button is pressed to start the operation of the machine on solving a problem, every step has to be worked out in advance in a "programme."

CONSTRUCTIONAL DIAGRAM FOR BIPLANE


1/8" ROUNDED BAMBOO STRIP WING TIPS
1/16" x 1/4" BIRCH
THREAD BINDING
18 S.W.G. WIRE HOOKS
1/8" BALSA GUSSET
CARTRIDGE PAPER TUBES TO TAKE 1/4" DOWELS
1/16" x 3/8" BALSA
1/16" 3-PLY GUSSET
1/8" BALSA GUSSET
1/4" x 1/8" SPRUCE
PLAN
48 1/2"
11"
RUBBER BANDS STRETCHED BETWEEN HOOKS
MAIN PLANES FIXED TO FUSELAGE FIRMLY WITH 1/4" STRIP RUBBER BANDS THUS MAKING STRUTS QUITE UNNECESSARY
ALL RIBS CUT FROM 1/16" HARD BALSA
DOUBLE RIBS AT DIHEDRAL
6 1/2" GAP
FRONT VIEW
35"
ALL SURFACES COVERED WITH HEAVY PAPER. THEN GIVEN TWO COATS OF GLIDER DOPE & FINISH WITH ONE COAT OF BANANA OIL
1/8" ROUNDED BAMBOO STRIP WING TIPS
1/4" BIRCH DOWELS
1/8" - 1/4" BIRCH
1/16" 3-PLY GUSSETS
1/4" x 3/8" BALSA
1/8" x 1/8" SPRUCE
1/16" 3-PLY TO TAKE DOWEL PEGS
CARTRIDGE PAPER TUBES
1/8" BALSA GUSSETS
PLAN
SCALE — INCHES



HOW TO BUILD A MODEL BIPLANE

On many occasions I have seen beautifully finished flying models become total wrecks, often only a very few minutes after being taken out of their transport boxes on the flying field. It has made me feel sorry when I have seen their owners sadly picking up the pieces and throwing them back into the box, all too quickly, without having had the pleasure of even one decent flight out of their machines.

by Frank Hughes

NOW good models demand many hours of interesting but quite painstaking labor to build, and often the burning of quite a drop of "midnight oil" as well, to say nothing of the expenditure of a certain amount of cash. Is it to be wondered at, that after a few "write-offs" like that just mentioned, many fellows are apt to become discouraged, even to the point of giving up in despair?

Actually, there is no need for this, as the remedy more often than not rests with yourself. Think carefully—did you really allow for that sudden dive in, or that bumpy landing, &c.? Or did you cut down the weight to such an extent that you left your model too frail to stand it?

I have examined many of these "lightning crack-ups"—lightning in both senses of the word—at various times and places, and I have invariably noticed the same errors being made by many—"faulty construction," "bad joints," "unsuitably small section materials," and often the trouble has been a combination of all three.

WEIGHT

When building a power model it is best to bear in mind the fact that your machine will be carrying the weight of an engine, and that the weight will be concentrated in one spot—a totally different state of affairs to the rubber-driven model, where the power weight is usually distributed over best part of the length of the fuselage. This is a fact that apparently is often lost sight of, as quite a number of crashed machines that I have closely examined were of such flimsy construction as to be quite unsuitable for the job they had to do, particularly where the fuselage framework and often the undercarriage were concerned.

Having built my first flying model in 1910, a Henri Farman biplane, and being something of an "old-timer" on the subject, having designed and built model aircraft of all possible types, this long experience has taught me not to hurry construction, and also never to sacrifice strength for the sake of being afraid to add a little more weight.

STURDY CONSTRUCTION

To proceed with details of this model, I put all I knew into it, combining sound construction with good shock absorption. The machine thus has a fair chance of many interesting flying minutes—even hours—bringing it safely back day after day, and what's more, "in one piece."

On one occasion the machine flew right away and was lost for five days, when the finder was kind enough to deliver it back to me, quite unharmed. (Another proof of the common sense of putting one's name and address clearly on your model.) It had landed quite a tidy step away from its take off. It now has over six hundred flights to its credit, with a total damage of a bit of paint knocked off and two broken airscrews.

The machine is the result of much thought and care in designing and building, and I think the reader will agree that it is not exactly easy to build an engine-driven model biplane that performs well in the air and yet is capable of taking hard knocks repeatedly.

CONSTRUCTIONAL DETAILS

The machine is quite a straightforward one to build and should present no particular difficulty, even to an enthusiast who only has a good general knowledge and not a lot of experience behind him in biplane building.

You will notice I have entirely done away with interplane struts—these are a common source of annoyance in a crash.

The upper and lower mainplanes are both rubber sprung to the fuselage with strong strip rubber bands, the tailplane being fixed likewise

The 12g. steel wire undercarriage is rubber sprung front, rear and sides, and does its work very satisfactorily. The detail drawing, Fig. 1, shows clearly the method of springing the two rear legs of the undercarriage. Upon impact with the ground the brass tubing containing the rear legs is forced back and upwards in a curved direction, the rubber bands expanding at the same time and taking all the shock. Sorbo airwheels are used, as I find them not too heavy and very suitable for this type of undercarriage and for general hard wear.

I suggest building the fuselage first, in the usual manner, both sides being built upon each other and the horizontal connecting formers then added, taking great care to get everything quite true.

Then attach the metal engine bearers by glueing and bolting to the 1-8in. three-ply upright, which is made lighter by cutting away a central portion with a fretsaw, then backing it with balsa. Now cut all the three-ply strengthening pieces to exact size and shape, being careful to follow the curve necessary for the rear undercarriage legs carrier to work into. Then very strongly glue and bind into position the brass tubing which is to take the front legs. Details are clearly shown in the fuselage drawings, Fig. 1. Be quite sure you cut all struts and cross-pieces *quite squarely* at their ends before glueing, and, most important of all, *double glue every joint you make*, allowing the first coat to become throughly dry before you apply the second one.

The latter hint, of course, applies to the whole machine and not only to the fuselage.

THE UNDERCARRIAGE

This is made from 12g. steel wire. Bind all joints with fine florist's wire before soldering them. When making the rear legs carrier you will find it much simpler than it at first appears. The unit is very strong and will stand up to practically anything. The rear skid is made from 18 s.w.g piano wire, bound firmly at its top to a bamboo peg, which in turn, is glued to the hard balsa block at rear of fuselage on the underside.

THE EMPENNAGE

This is next built as shown in Fig. 1. It is of sturdy construction and the drawings are self explanatory.

The tailplane section is shown in Fig. 3.

MAINPLANES

The upper mainplane is built up on the plan of same (Fig. 4) and is in three pieces: a centre section, port, and starboard wings. The correct dihedral angle is shown in the front view and the wing section used is seen in the detail drawing (Fig. 3).

The lower mainplane is built up in exactly the same way, only it is in two sections, as shown, the join at its centre, allowing of very easy fixing between the front and rear undercarriage legs.

Note that the dowels are quite free in the tubes, and are not glued to one side as is the usual practice. I find that in a bad crash these

AMATEURS—DISPOSALS—EXPERIMENTERS

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dowels may be broken without breaking the plane, and the fixing of a new one is simplicity itself if you carry to the airfield one or two spare ones already cut to the required length. All that is necessary is to shake out the broken piece and insert a new one in its place.

COVERING

The covering of the whole machine is strong rag tissue, water doped, then given two coats of glider dope, allowing each one to dry well before applying the next. Then finish with one coat of banana oil. After this the mainplanes, tailplane fin and rudder can be edged with "joy" cream enamel, which gives it a very pleasing appearance. Of course, the builder can please himself about this latter refinement.

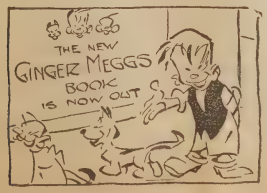
Another practice I adhere to as much as possible is to let my machines take off unaided. Of course, it's not always possible to find the necessary "strip of straight and even," but on the whole my machines do much more R.O.G. than hand-launched flights. After all we do fit undercarriages to our machines, so why not use them more often. Besides, it is more realistic to see your model commence its flight R.O.G.

This machine is not intended for competition work, although I have no doubt it could well hold its own in that field; but the model aeroplane enthusiast who likes a fairly good sized machine that will fly steadily and consistently, doing its two to three minutes, with an absolute minimum of damage, will not be disappointed with this biplane.

The engine, a 2 cc E. D. Mark II, is such a reliable one that it needs no comment here. Installed in this model, the whole forms an excellent combination, giving many pleasant days of "good sport" in return for the care and effort expended during construction.

AN artificial hand with working fingers that look as natural as the purely cosmetic ones sometimes seen is now available in America. Motive power for flexing the fingers is provided by a pneumatic bulb strapped in the wearer's armpit, with a tube leading to a cylinder-and-piston arrangement in the palm portion of the hand. A series of levers and lines that flex the fingers are moved in varying degrees according to the pressure applied on the bulb and the position taken by the arm to which the hand is attached.

THE private life of an oyster or what goes on under the shell can now be studied by a new electronic device.



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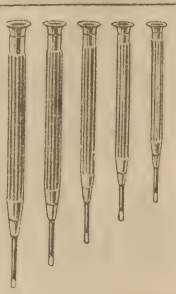

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Numberdrills 0-60 on Stand, 61 drills per set, 78/-.

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6" Jeweller Snips .. 8/6

Gilbow Tinsnips, 10" 10/6; 12" 12/6; 14" 16/6.

U.S.A. Tappet Spanners, 7-16 x 17-32, 6/- each; 5-8 x 11-16, 6/- each.

King Dick Tappet Spanners, 7-16 x ½" SAE, 9/3 each; 3-16 x ½" W, 9/3 each.

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Eclipse or Vanadia Engl. Carbon Power Hacksaw Blades, 12 x 1" x 18g, 10 or 14T, dozen, 7/6.

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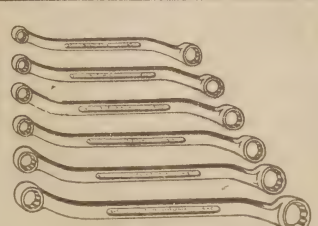

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YOUR CHASSIS AND CABINET

(Continued from Page 63).

rest must not obstruct access to record storage slots or get in the way of the lid-tilting mechanism. Finally, the rear end of the pickup must not foul the back of the cabinet at any point in its travel.

When the pickup and motor are installed as separate items, some additional points have to be watched.

Magnetic pickups are likely to pick up hum from the windings of the motor, so that, on principle, the motor should be mounted in a way which puts the windings and fields as far as possible from the pickup head. If the best position can be checked in the rough beforehand, so much the better.

In some cases a compromise is necessary where the pickup must actuate an automatic stop. Unless the correct position is quite clear, it is a good idea to mount the pickup and motor first on a scrap of plywood or masonite, get everything working properly, and then use this as a template to cut the motor-board itself.

Watch the pickup tracking law and make sure that the pickup base is mounted at the prescribed distance from the motor spindle. In most cases the needle-point has to overshoot the centre of the spindle by about 3/8in.

When the motor is installed, connect it to the power mains, switch on, and listen for hum caused by vibration of the motor-board. Sometimes slackening or tightening a particular mounting screw will reduce the hum level, although this is more a relief than a cure.

If the motor has more power than necessary, rumble effects can often be reduced by wiring a large globe in series with one of the 240 volt leads, or in some other way lowering the motor terminal voltage. This scheme applies particularly to governor-type motors.

If the motor-board vibrates mainly because it is of light timber—3/8in ply is commonly used—the vibration can often be cut down by screwing a 2in x 1in cleat edgewise beneath the panel and stiffening the unsupported middle section.

A somewhat related problem is likely to occur when the receiver is put in use. Turning up the gain on "gramo" with a record playing, or advancing a possible bass control may cause the whole installation to rumble and vibrate violently. This is acoustic feedback from the speaker cone, through the cabinet timbers to the needle-point.

The cure, or combination of cures, is likely to be different in every case. Try bracing the motor-board from beneath, as already mentioned. Try mounting the whole motor on rubber pads or, alternatively, locking it firmly to the base-board. Try mounting the pickup base on a rubber pad. Try cross-bracing in the cabinet itself and, as an extreme measure, float the top edge of the

(Continued on Page 91)

HOW TO BUILD A MODEL OF AN AUSTRALIAN MOTOR SHIP.

M.V. EUGOWRA. 500 TONS - BUILT IN MARYBOROUGH - 1948.

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HULL - BLACK RED WATERLINE WHITE LINE ROUND HULL
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WINCHES - GREY - VENT - WHITE -
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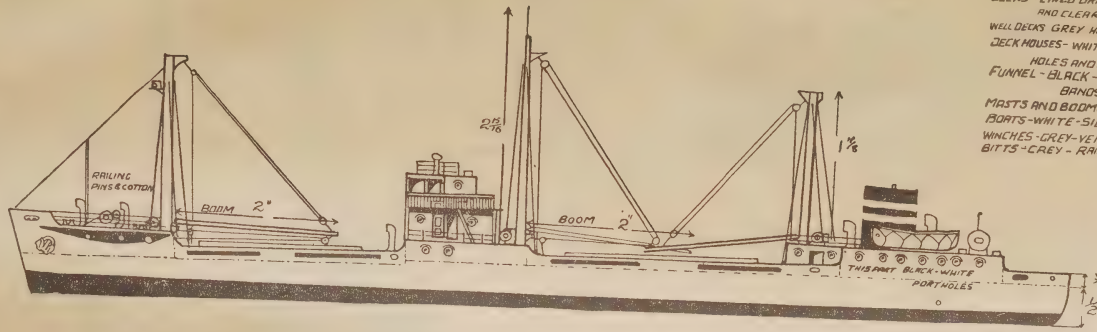

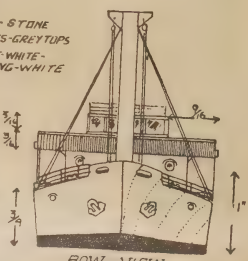

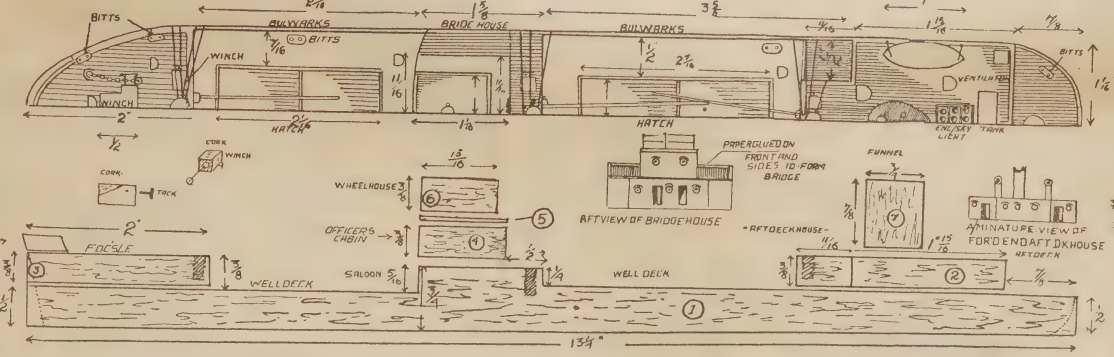

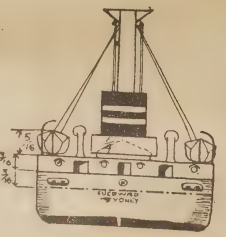

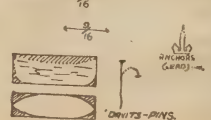

THE HULL IS MADE FROM A PIECE OF BALSA WOOD 13¼ X 2⅛ X 3/8 THICKESS PART BEING AMIDSHIPS - THE TOP DIAGRAM GIVE FULL SIDE VIEW SHOWING ALL DETAILS AND RIGGING - THE MASTS CAN BE MADE FROM WOODEN BUTCHERS SKEWERS. AND BOOMS FROM BAMBOO OR SPLIT CANE. WINCHES CAN BE CUTOUT OF CORKS - HATCHES, STOUT CARD, VENTILATORS, CURVED MACARON BEADS FOR RIGGING BLOCKS. ANCHORS - THIN SHEET LEAD - BULWARKS FOR WELL DECKS - STOUT CARDBOARD GLUE INTO POSITION - MIDSHIPS DECK HOUSES, CONSIST OF 2 BLOCKS OF WOOD - LOWER ONE = 3/8 X 1 1/16 X 1⅜ AND THEN A STOUT CARDBOARD DECK MESURING - 1 1/16 X 2⅛ THIS DECKING IS LINED WITH INDIAN INK - SIGNIFYING PLANKS SIMILIAR TO ALL DECKS BUT WELL DECKS - THE AFTER DECK HOUSE IS ONE PIECE - CUT AS MESURED - ON PLAN - THE FUNNEL CARVED FROM ONE PIECE (OVAL) 7/8 X ¾ X 3/16. THE AFT BULWARK IS A PIECE OF CURVED LEATHER GLUED INTO POSITION - ENGINE ROOM SKYLIGHT CARDBOARD - IT IS ADVISABLE - THAT ALL PARTS BE MADE UP FIRST AND THEN PAINTED - BEFORE PUTTING TOGETHER AS IT MAKES A NEATER JOB. A HOLE IS DRILLED ON BOTH SIDES OF THE BOW FOR ANCHORS

C. SEYMOUR ENGINEER M.N.

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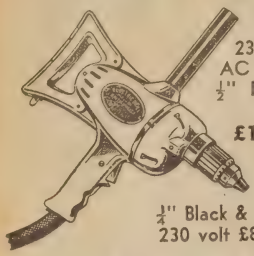

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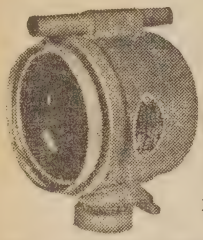

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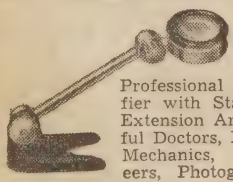

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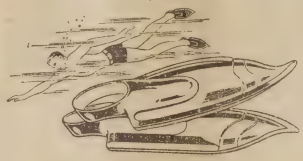
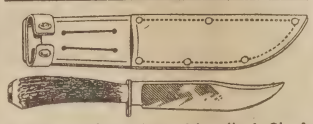
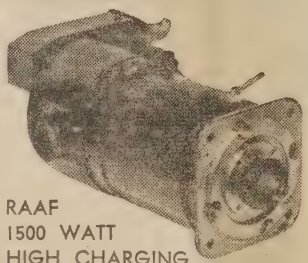


£3/7/6 per pair.

Double your swimming speed.



British Make, Horn Handled Sheffield Steel Hunting Knife .. 22/6



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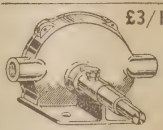

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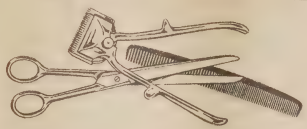

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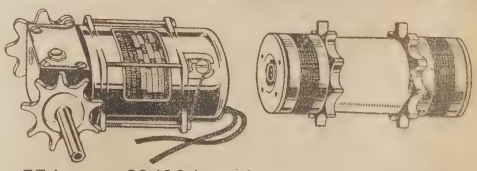

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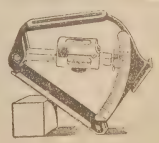

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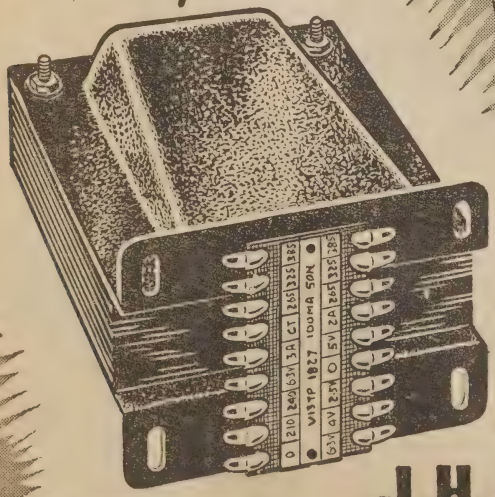

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F.M. RECEIVER

Continued from page 53

words, for a given signal input and frequency deviation, the discriminator will deliver more audio output than will the ratio detector.

The chassis on which the receiver is built is quite compact, measuring 12in x 8in x 2in. The only controls fitted to the receiver are the OFF-ON switch, volume control and oscillator trimming condenser. As mentioned before, a continuously variable bass control could be fitted if desired.

TREBLE BOOST

It would also be possible to fit a treble boost and cut control to the receiver. This could be done quite easily by fitting a larger de-emphasis condenser and returning it to earth via an 0.5 meg. potentiometer connected as a rheostat. This would allow the de-emphasis to be increased or decreased at will, thus providing effective treble cut or boost.

To outline a few constructional details, the aerial coil is the same as specified in the original receiver. The grid winding consists of two turns of 12-gauge wire, wound to an inside diameter of ¼in and opened out to leave a 1-8th inch spacing between turns. It is tuned with a 3-30 pF. air trimmer.

The primary winding, connected directly to the aerial input terminals, consists of a single turn of 16-gauge wire mounted close to the earthy end of the grid winding.

The oscillator coil is wound to the same specifications as the aerial coil and mounted directly under the oscillator socket. It is tuned by a 30 pF. air trimmer, acting as a bandset condenser, with a 2 or 3-plate midget condenser above the chassis for panel adjustment. The cathode is tapped in at slightly less than half a turn from the earthy end. The above-mentioned midget condenser taps in at this same point.

Use a 30 pF. air trimmer for the injection condenser and adjust for optimum results. Too little coupling will lower the performance, while too much will render the receiver unmanageable. Our condenser ended up at about one-quarter full in, representing an injection capacitance of about 10 pF.

COVERAGE

A certain amount of "juggling" will be necessary to get the injection and the coverage right, and the oscillator bandset, in particular, needs careful handling. Once set, however, it need not be touched again.

For the IF transformers you will need components especially designed for use in FM receivers. Two straight transformers will be required, and a discriminator transformer. The first two transformers will normally be loaded internally with resistors to give the required bandpass and "Q" factor. Our circuit prescribes certain loading values, but they may differ somewhat from the actual values which the manufacturer includes in his transformers. Always allow the manufacturer to decide this matter in the light of

Continued on page 89

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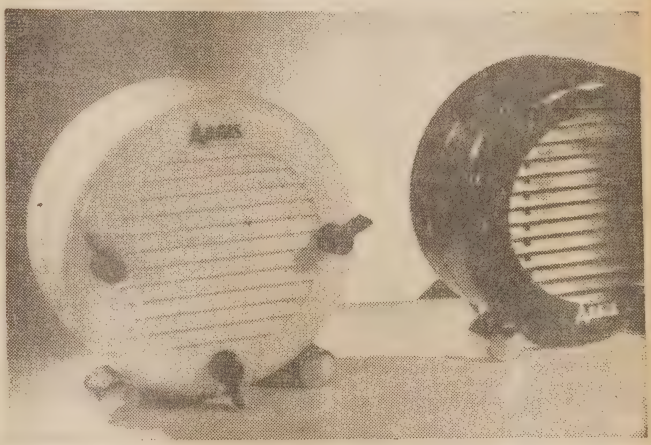

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SHORT WAVE NOTES BY RAY SIMPSON

We occasionally receive letters from listeners who are anxious to know when particular programmes can be heard from some high powered American and European stations. It is obvious from their letters they are more interested in listening to one particular programme than hunting for the elusive long distance station. As a general rule, short wave notes cater more for the latter listener than they do for the former and these notes are no excepion.

THE assumption is that those listeners who wish to listen for an hour or so to one particular short wave station because they enjoy the particular programme, are usually content to tune either the ARFS or Voice of America programmes from the USA or alternatively some of the entertaining sessions from the BBC.

If this is the case, they soon learn at what times and on what frequencies to listen and can make this even more definite by obtaining the programme schedules in advance from the stations concerned.

Even though the writer has always found more enjoyment by looking out for and identifying new stations, on many occasions he may stay tuned to one station for hours on end just enjoying reception on account of the entertainment being provided.

We still consider that more listeners are interested to hear of new stations, verifications ,and general short wave news items, but are quite willing to include in these notes, details of regular short wave programmes which listeners may wish to hear.

When next you write, give us your opinion on this subject and we will endeavor to so arrange these short wave pages that no matter what your particular fancy may be, there will always be a few items which will particularly appeal to you. There is room for both and we have no wish to neglect any phase of short wave listening which would be of interest to any section of our readers.

MOSCOW WINTER SCHEDULE

WE are indebted to Mr. John Nowlan for the winter schedule of Radio Moscow which will prove of interest to many listeners who have been unable to locate the USSR station in its English transmissions. From our own observations there appear to be other outlets than those given in this schedule, but as is often the case with Moscow, they are not consistent and change from one frequency to another without any warning.

2.00 am to 2.30 am (Mon. only).—6.00 mc, 50.00 m; 6.09 mc, 49.26 m; 11.63 mc, 25.79 m.

3.30 am to 4.00 am.—6.00 mc, 50.00 m; 6.09 mc, 49.26 m; 7.32 mc, 40.98 m; 11.63 mc, 25.78 m.

5.30 am to 6.30 am.—6.00 mc, 50.00 m; 6.09 mc, 49.26 m; 7.34 mc, 40.87 m; 9.67 mc, 31.02 m.

7.30 am to 8.00 am.—6.09 mc, 49.26 m; 7.34 mc, 40.87 m; 9.67 mc, 31.02 m;

8.30 am to 9.00 am.—6.00 mc, 50.00 m; 6.09 mc, 49.26 m; 7.34 mc, 40.87 m.

On Tuesdays, Fridays and Sundays, concerts are given from 8.00 am to 8.30 am on 6.00 mc, 6.09 mc, and 7.34 mc, while on other days the programmes consist mainly of talks and news bulletins

From around 8.00 pm there are quite a number of Russian stations with musical programmes, one of the loudest being on 5.94 mc, while another nearly as loud can be logged at 5.72 mc. In the portion of the band between 9.7 and 9.8 mc there seems to be quite a number of Russians around 7.0 am but no clue can be given as to their actual location.

HH3W CHANGES CALL AND FREQUENCY

IN last month's "New Station Loggings" panel we mentioned a station 4VRW as being heard on 9.795 mc at 10.00 pm, but did not have sufficient room to give any details.

This station is identical with HH3W which used to be heard on 10.13 mc. In company with other Haiti stations, HH3W is now operating under its new call sign consisting of a numeral followed by three letters, but what is more interesting is the great increase in strength. This station comes on the air any time from a few minutes before 10.0 pm till as late as 10.15 pm and usually plays recordings for about ten minutes before making any announcements. When the opening announcement is finally given it is preceded by four chimes and then identification in French followed by the following in English, "This is broadcast station 4VRW in Haiti." During the week before Christmas they gave a great number of carols and such like, which made it very easy to compile a report. One of their favorites was Silent Night, which was played on each night we listened to the station, while another which was very popular was O Come All Ye Faithful. This station had a poor reputation as to verifying listeners' reports and we hope that now they are using their new call and possibly increased power, they will show more readiness to send along their verification card.

SHORT Wave Notes for the March issue are due on February 4th. For the April issue they are due on March 11. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

STOP PRESS ITEMS!

PAKISTAN LISTING NEW FREQUENCIES

SINCE compiling the main portion of our notes we have noticed that Radio Pakistan is now using another new frequency, namely, 11.81 mc. which comes on the air at 10 pm with the news in English in parallel with 11.77 mc. This new channel is a bad spot as VLC7 also uses this frequency from opening at the same time.

According to Radio Australia DX session, Radio Pakistan has also been testing on 15.15 mc. around 5.30 pm but has now discontinued this outlet in favor of 17 835 mc.

WHO IS ON 15.145 mc. AT 10 pm?

For a few nights now we have been hearing a station on 15 145 mc from around 10.0 pm. It is very difficult to follow, due to London on 15.14 mc and Djakarta on 15 15 mc., but it sounds very much like Lisbon This seems to be confirmed by the fact that on two occasions we have heard the announcement, "Emissora Nacional" plus the fact that the language used is Portuguese

Our only other guess is that it is ZYK2 in Brazil which, of course, also uses Portuguese but is not Emissora Nacional.

THESE STATIONS VERIFY

EA8AB, CANARY ISLANDS: A very interesting verification card was recently received by Rex Gillett confirming his reception of EA8AB on 7.52 mc. Their card is an attractive one, with the Spanish colors in the form of two bands, red and yellow, across the top left corner with an imposing crest below.

The right hand side of the card gives verification details together with their short wave call, EA8AB, and broadcast band call, EAJ43. This station is situated in Santa Cruz de Tenerife and is operated by the Radio Clube Tenerife. Their postal address is Apartado 225, Santa Cruz de Tenerife, Canary Islands.

KOL-YISRAEL: Both Art Cushen and Rex Gillett have received their verifications from Kol-Yisrael confirming reception on 6.83 mc and 9.0 mc and, in the case of Rex Gillett, this made his 112th country verified, which is indeed a very fine effort.

In their letter the station said they were using 2.5 kw on 6.83 mc from Tel Aviv, working into a semi-directional dipole antenna, while the 9.0 mc transmitter is operating with a power of 7.5 kw working into a rhombic antenna directed to western Europe and the East Coast of the USA. They also mentioned that the station heard on 8.17 mc is only of "minor output" and is situated in Haifa These stations have been slow to verify so it is nice to know they are now arriving.

DZH7, PHILIPPINES: An air mail letter has just arrived from Mr. Robert H. Bowman, the new vice-president of the Far East Broadcasting Co., verifying reception of DZH7 on 9.73 mc (actually they are on 9.74 mc). We are pleased to note that our report was the first received from any listener on DZH7, similarly to DZH6.

Mr. Bowman stated they are only using their driver unit with a power of 300 watts, but they were erecting a "V" beam to be centred on Bombay, India, and will then increase power to 3000 watts. He also said that the station would be interested to hear if DZH7 was still audible in Australia after their power was boosted and the antenna directed to India. He thought this to be unlikely, but at the time of writing we can still hear DZH7.

HJEX, COLOMBIA: This well-known South American station, HJEX, sent along a very interesting letter of verification in Spanish confirming reception of their transmission on 6.054 mc. It was in the usual polite form of such letters and said further reports would be appreciated. Their slogan is "Radio Pacifico," Emisoras de Cali Para America, and their address is given as Apartado Nacional 559, Cali, Colombia

They also list the broadcast band outlet HJER as being on 1030 kc. Their letter was sent by air mail and had a very colorful display of eight postage stamps and, what was rather strange, came by way of Caracas, Venezuela, which is somewhat off the track for Australia.

HOJA, PANAMA: Thanks to Mr. J. Rolfe, of Mitcham, Victoria, we have had the opportunity of inspecting his verification card which he received from HOJA in Chitre, Panama. Although the card is a very plain one, it is a very good catch indeed. At the top left is given the name of the station, "Radio Provincas," with a circle and call letters below and then a map of Central America below that again.

At the right they give their call letters again with frequency 9.645 mc. Location is Chitre, Province of Herrera, Panama, and the proprietors are Gaspar Reyes, Fernando Joly and Ramon Pereira. Their power on HOJA and also their broadcast band station HOJ is 500 watts.

FLASHES FROM EVERYWHERE

SAO, THOME: Here is an entirely new country for every listener, we think, and according to overseas magazines, a short wave station began operations on October 1st transmitting with a power of 1 kw over CR5SA on 11.785 mc and CR5ST on 9.615 mc. At the present time it is not clear whether the station is located on the island of Sao Thome or the adjoining one of Principe.

Both these islands are situated in the Gulf of Guinea and the stations are operated by the Radio Clube de Principe and S. Thome. As these are Portuguese islands, all programmes are in that language. No schedule is known, but we should say the early morning would be the best time to look for them.

PHILIPPINES: In last month's issue we mentioned a new Philippine station which had been heard for some weeks operating on a frequency of 4.98 mc. We stated that when first heard we understood the call letters to be DYBR and this has been confirmed by our New Zealand correspondent, Art Cushen, who advises that the call is DYBR for the broadcast band outlet and DYB2 for short wave.

The station is known as "Radio Davao" and is situated in the town of that name in Mindanao, which is in the extreme south of the Philippines. Their schedule still seems to be 8.0 pm till midnight, but sometimes on a Saturday night we have noted them on the air until 1.0 am. Many thanks, Art, for your help in identifying this station.

SAUDI ARABIA: Here is another new country for most of us and if the number of frequencies in use is any indication, it should not be long before someone hears the new station which, we understand from Radio Australia, began operations last October. The programmes from this new station are all in Arabic and are on the air from 3.0 am till 4.0 am daily on the following frequencies: 3.96 mc, 5.985 mc, 9.645 mc, 11.76 mc, and 11.95 mc. The announcement given at the beginning of the programme is, "Mekka is broadcasting over Djedda on ." followed by the various channels mentioned above. Although the time on the air is rather inconvenient for listeners in Eastern Australia, we think someone will log them before long.

TRANSJORDAN: The very interesting weekly news sheet issued by Radio Sweden gives us some details of the short wave station which is operating from Ramallah. This newcomer is known as the "Hashemite Jordan Broadcasting Station," and is on the air at the following times on 7.075 mc: 3.45 pm to 4.30 pm; 9.45 pm to 10.45 pm; and 2.0 am to 5.30 am.

There is an English programme broadcast at 3.15 am till 4.0 am and as reception for this locality should be about its peak at this time, we recommend those listeners who wish to log this station to make an effort one morning and get up early, or make a late night of it and stay up till around 3.30 am.

MISCELLANEOUS: Just as we go to press we have noticed that Radio Pakistan is again using 17.835 mc for one of their outlets, possibly Dacca. The best time to hear them is at 5.10 pm when they give the news in English. The call letters for the new Indonesian station on 6.045 mc reported in last month's issue are YDF, while for the 11.795 mc outlet they are YDF3. Damascus is reported to be operating on 5.0 mc, 6.0 mc, and 11.75 mc with a programme in English from 5.0 am. Quite good signals can now be heard from Radio Tananarive in Madagascar on their 7.38 mc channel till closing with the Marseillaise at 6.0 am. A seldom-heard Egyptian station, SUV, has been logged on 10.544 mc around 4.30 pm.

Overseas magazines report another station in Tangier known as "Pan American Radio" and said to be operating on 7.4 mc and 15.05 mc from 10.0 pm, 3.0 am, and 7.0 am with programmes in English, French and Spanish. The Mauritius station, V3USE, is reported to have changed frequency to 15.06 mc and to be on the air from 12.30 am to 2.30 am. It would appear that Papeete, Tahiti, is now also using the old frequency of 6.98 mc in parallel with FZP8 on 12.08 mc from 2.15 pm to 3.0 pm. This outlet of 6.98 mc was the one used by FO8AA, which proved such an elusive station during the past few years. Munich is again being heard on 6.17 mc at 6.0 am and this station has also been logged on 23.74 mc, this being a harmonic of their transmission on 11.87 mc.

NEW STATION LOGGINGS

Call	KC	Metres	Location	Time Heard
KGEX	6155	48.74	Belmont, Cal. USA	7.00 pm
B.F.E.B.S.	6175	48.58	Singapore, Malaya	9.00 pm
A.F.R.	7170	41.78	Rangoon, Burma	11.15 pm
Tangiers	7220	41.55	Tangiers, N. Africa	6.30 am
HVJ	7280	41.21	Vatican City	6.30 am
Kol-Yisrael	8900	33.71	Tel Aviv, Israel	6.00 am
KCBR	9530	31.48	Delano, Cal. USA	11.30 pm
KNBX	9600	31.25	Dixon, Cal. USA	8.00 pm
Radio Nigeria	9655	31.07	Lagos, Nigeria	4.30 pm
YDF3	11795	25.43	Djakarta, Java	4.30 am
Paris	15100	19.87	Paris, France	9.30 pm
HSJ4	15910	18.86	Bangkok, Siam	8.15 pm
ZUD31	17226	17.41	Pretoria, South Africa	11.30 pm
Tangiers	21590	13.90	Tangiers, N. Africa	10.00 pm

NEW STATIONS OF THE MONTH

SOUTH AFRICA: Most listeners will have heard the excellent cricket rebroadcasts by the ABC covering the second Test Match held in Capetown. Equally good reception could be obtained by tuning direct to the South African station ZUD31 which was transmitting on 17.226 mc. This station was heard from 9.0 am till 9.15 pm and again from just before 11.30 pm till 12.05 am.

At that time they gave their call letters and frequency three times and said they would return to the air at 1605 GMT (2.05 am EAST) on ZUD28 on 13.186 inc. As we have received our verification for ZUD on 17.748 mc and ZUD28 on 13.186 mc, a report on ZUD31 should be equally successful we think.

SIAM: The Siamese Radio Authorities seem to be moving about on all bands and the latest outlet we have heard is one on 15.91 mc which plays Western type music from around 8.0 pm and at 8.15 pm gives the news in English, usually by a lady. This transmission is in parallel with that on 6.235 mc and on some occasions the one on 9.8 mc.

The call letters allocated to 15.91 mc are HSJ4 so we presume this is the station in use, though they may use their regular call of HS8PD. Morse interference is sometimes rather bad, but on the whole the programmes can be followed without too much difficulty. Let us hope they actually verify 15.91 mc and not 6.01 mc as they are inclined to do most times.

NIGERIA: Our thanks are due to Art Cushen for identifying a station we have been hearing for some time now on 9.655 mc and it has turned out to be a really interesting one and a new country to boot. This new one is "Radio Nigeria," located in Lagos, the capital of Nigeria in West Africa.

The station has been heard as early as 4.10 pm, when it rebroadcasts the BBC news and then sometimes other BBC programmes till closing at 5.15 pm after giving the local news. We thought it was another outlet of the Forces Station in Malta and did not even wake up when we heard Lagos mentioned in the local news, but Art Cushen soon cleared it up and thus we have a new country for most listeners we think.

BURMA. Our South Australian correspondent, Rex Gillett, is always well to the fore in logging new stations and we have to thank him for information concernings two new stations in Burma. The first is one which has been heard for some time now on 7.375 mc till closing at 11.30 pm, and which has now been identified by Art Cushen as being located in Mandalay.

The second station is on 7.17 mc and the news in English can be heard from about 11.15 pm when they announce as the Armed Forces Broadcasting Service in Rangoon. English recordings are then played till after 11.30 pm, when the station reverts to native type music. Amateur interference is very severe on this latter station on most nights.

TANGIERS: What appears to be one of the new Voice of America stations has recently been heard in Australia at very good strength. At our own location the only outlet which has been heard is the one on 7.22 mc, which is really very fine from around 6.0 am and can be followed till 8.0 am.

In addition to this outlet, however, Rex Gillett has heard them on 21.59 mc from 10.0 pm till 10.30 pm, and, according to overseas reports, Tangiers is also testing on 11.73 mc. It would seem, therefore, that they will also soon be heard on one or other of the other short wave bands. The programmes are all rebroadcasts of the regular Voice of America programmes from New York and we have not as yet heard any local material.

MISCELLANEOUS: Hardly a month goes past without one or two new USA stations, and this month we have KNBX now operating on 9.6 mc with a very nice signal from 7.0 pm. Opening at the same time we now also have KGEX on 6.155 mc, which is rather difficult to separate from VLR2, but when the latter leaves the air KGEX is excellent. Still another American is KCBR, which is now using 9.53 mc from opening at 11.30 pm, and this one, too, is very good on most nights.

Paris has been heard opening on 15.1 mc at 9.30 pm when they give a programme in Italian till closing down at 9.45 pm.

Mention was made last month of the new 100 kw transmitter being used by Radio Indonesia and since that time we have heard them at great strength operating on their alternate frequency of 11.795 mc. We only heard them for a few minutes before they left the air at 5.0 am and it appeared as if it was a programme directed to the Netherlands as it was all in Dutch and frequent mention was made of Rotterdam, &c.

The BFEBS station in Singapore has now moved from 6.045 mc to 6.175 mc and the strength of signal has greatly improved with the change in frequency. Finally, we have Kol-Yisrael, with a change of frequency to 8.9 inc, whence it can be heard well around 6.30 am, and at the same time HVJ, Vatican City, has been logged on 7.28 mc, but smothered by other stations on nearby channels.

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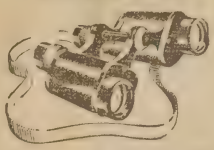

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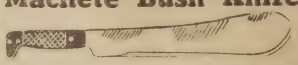

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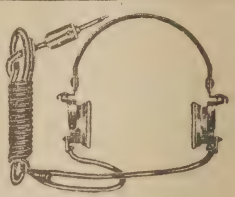

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THE HAM BANDS WITH BILL MOORE

The A.R.R.L. Board of Directors at a special meeting decided on a general policy towards the new F.C.C. proposed Amateur Regulation Changes previously analysed in the September issue of Radio and Hobbies. The purpose of the decision was to brief delegates to attend a conference to discuss these proposed changes In attendance would be representatives of the F.C.C., the A.R.R.L. and other interested bodies.

GENERALLY speaking, the ARRL Board opposed the suggested changes.

One point they agreed to was the extension of the Class A 75 metre from 3800 to 4000 kc/s. They strongly opposed any limits on the width of telephony transmissions. It was proposed that transmissions be kept to within the following limits:—3850 to 4000kcs and 14,200 to 14,300 kc/s—6 kc/s, 3880 to 3850 kc/s—3 kc/s, 28,500 to 29,600 kc/s — 10 kc/s, 29,600 kc/s to 30,000 kc/s—6 kc/s and a limit of 20 kc/s in the 50 mc band.

The board rejected all other proposals affecting the 14, 28 and 50 mc bands excepting the extension of narrow band frequency modulation facilities from 50 through to 54 mc/s.

The technical class of licence met with support, the proposal allowing full amateur privileges on all bands above 220 mc/s, with only a limited Morse speed requirement of five words per minute.

The board also supported the novice class of licence with the same Morse requirement, 5 WPM. Transmissions are restricted and licencees must operate only using crystal control, and a power of 75 watts. Originally transmissions were to be permitted from 3700 to 3750 kc/s, 14,100 to 14,150 kc/s, 28,000 to 28,500 kc/s on CW and from 145 to 147 mc/s on CW or telephony.

The ARRL Board suggests operation on CW from 3700 to 3750 kc's and 26.99 to 27.23 mc/s only, and CW or telephony from 145 to 147 mc/s. The board's ideas seem to be wise in the light of the crowded conditions of the 14 and 28 mc bands, and the obvious interference to foreign telephony stations between 14,100 and 14,150 kc/s, the board again expressing the wish of not only American amateurs, but that of the majority of the world's amateurs.

"EXTRA FIRST"

Extremely vigorous opposition was displayed to the establishment of an "Extra First" class of licence, and to the additional code requirement of 20 words per minute also to the re-examination of present class A licence holders. Class A type licences are at the moment the highest class granted, and it is necessary to hold this class of licence before being permitted to operate telephony on the 3.5 and 14 mc bands.

The proposal that it be compulsory to appoint a control station for all net working did not receive support.

An interesting point decided upon, but not arising from the FCC proposals, was a request by the board to the FCC concerning the extension of the 14 mc. telephony allocation. It has registered the suggestion that, on the opening of the 21 mc band granted at Atlantic City to American amateurs, the 14 mc band telephony allocation be extended by 50 kc/s to 14,350 kc/s.

As under that convention we lose 50 kc/s of the 14 mc band, it means that the US telephony allocation will extend to the edge of the band. The change leaves no space for foreign phones as at the moment, and they will be forced to operate on the lower frequency section of the band.

The above reactions are those of the ARRL board of directors and will undoubtedly affect to a large degree the final decision of the FCC.

The first post-war national convention of the Radio Society of Great Britain was held at Manchester late in 1949. It was also the first occasion on which an event of this type was held outside London. The organisation was left to a group of local amateurs headed by G6OM. It was a tremendous success, over 700 members attending of a total of 1000 present.

Amateurs in the British Isles may now use higher power on their UHF bands, as under a recent decision of the Post Office 150 watts input is permitted on all bands above 28 mc with the exception of the 420 to 460 mc band where 25 watts is the limit. The facility was granted after negotiation by the RSGB, and is for a period of one year only. After this period has expired, the permit will be reviewed in the light of the results obtained, and the number of cases of BCI reported.

THE UHF'S

INCREASED activity on the 50 mc band this summer has resulted in many more contacts being made. Country stations in most States have been operating and often they have been within range of capital cities in other States, when sporadic E reflections did not allow working between capital cities of the States concerned.

There are possibly twice as many stations active on 50 mc this year.

Bob Godsall, VK2ARG under the call sign of VK2ARC (portable), has been supplying a new interest by operating mobile on an aircraft flying between Sydney and Hobart.

On one trip he contacted VK2AH in Sydney until he reached Holbrook, NSW, a distance of 350 miles. VK2PN, of Tumut, then took over and continued until VK2ARG was in range of the Victorians. Later he contacted the VK7's.

VK2ARG has been heard in New Zealand and Western Australia during these trips. He used 18 watts input to an 815 and a long wire antenna; but hopes to improve the latter with better results.

Quite a number of "firsts" were recorded during December. VK7XL working VK6WG at 1904 hr. EAST. December 16 for the initial contact between these States. VK7XL incidently has been working extended ground wave across Bass Strait, a distance of 200 miles.

VK4CU raised JA2AZ for the first Australian.

ZL1UZ worked through to Western Australia at 1500 hr. EAST on December 15, a first between NZ and the West.

Contact for the first time was established between Fiji and Australia on December 18, when VK2AH and VR2BC hooked up. The latter using 25 watts input to an 807 valve cathode modulated. The antenna and 8 waves long wire. VR2BC has also been working into New Zealand.

The period 15th to 18th of December was particular suitable for UHF working and during the weekend December 17 and 18, the best openings for the season occurred, some of them lasting for six hours. Three-hour openings were common. VK2AH contacting 18 different ZL's during one break through, while VK2ABC tallied 45 ZL's for the weekend.

Startling overseas news on the 144 mcs band was the confirmed reception of FA8IH of Algiers, by G6UH in England over a distance of 1030 miles, a little farther than the recently-established US record. The FA was first heard calling CQ and later working an F station. FA8IH was using CW and his his signals peaked at RST-569 in Middlesex.

On the following day the two stations were in communication on 28 mc and both log entries checked.

On December 15 VK2TA reported hearing a W5 station for a brief period, and judging by the number of W stations that have been heard the time is not too distant when the Pacific will be bridged on 50 mc.

Extremely good conditions were experienced during the holiday season, interstate contacts and contacts with New Zealand were so numerous that it would take pages to record. Two good feats could be mentioned as highlights. VK6WG in the space of just over two hours contacted all States in Australia and one district in New Zealand, while in the brief space of 40 minutes a VK5 communicated with all Australian States and districts in NZ.

NSW NORTH COAST CONVENTION

CRIEFF RETTALICK, VK2XO, Col. Fletcher, VK2ASF, and Peter Alexander, VK2PA, organisers for the WIA's North Coast zone conventions, are determined that the 1950 event will be the best and most comprehensive amateur radio event ever organised.

The scene, the same as last year, will be Urunga, and the date Easter weekend, April 8, 9 and 10. The programme has been arranged to cater for all members of the family and general entertainment is being arranged in conjunction with the Urunga Progress Association.

Besides the usual Ham entertainment, the following events have been arranged: Surf carnival, motor bike races, dances, fireworks display, aquatic sports, picture shows. Especially for the amateurs are competitions, lectures, 144 mc search and plenty of prizes.

The Urunga Hotel has been completely booked for the weekend and if you require accommodation contact VK2XO at Raleigh as soon as practicable. It is anticipated that large crowds will be in attendance including visitors from Queensland. If you are going, let VK2XO know immediately.

DIARY, 1949

EVENTS and milestones pass so quickly in "Amateur Radio" each year that a brief review of the events in Australia for 1949 may prove of interest.

Outstanding was the emergency work of Amateurs during several disasters. Late June saw Vic Holmes, VK2AKP, supply the only means of communication with isolated Maitland, a feat to be repeated in August when Chas. Peddel VK2KN, kept Kempsey in touch with the outside world during the devastating Macleay floods. VK3WE VK2PA and VK2SH supplied communication during local emergencies. Amateurs during the year saw much of this type of working and many co-operated.

VK7LE introduced SSSC transmissions to Australia, and later in the year many others were using this type of emission with little co-operation from the AM gang.

The VK7's made a clean sweep in the WIA's Remembrance Day Trophy, winning by a large majority.

An Australian station won the 1949 BERU senior contest, Gordon Cole, VK2DI, the culprit, while Frank Hine, VK2QL, managed second place in the junior section.

While on the matter of contests, another DX contest was organised during

the year by Amateur Radio Club of India.

The Victorian Division of the WIA introduced accurate frequency transmissions on the 7 mc band for the first time in Australia.

During Easter the 19th annual Federal convention of the WIA was held in Melbourne.

On the UHF's, signals were exchanged between Hawaii and Eastern Australian States for the first time. Bob Godsall, VK2ARG, was the first to get through, although back in 1947 Clarrie Castles, VK5KL, performed the feat.

On 1st August there were 2727 Hams licenced in Australia.

We also saw the first 80 metre WAC's recorded, Jack de Cure, VK5KO, and Ray Priddle, VK2RA, performing the feat.

For the first time amateur activity was noted from Antarctic VKI's on Macquarie Island and Heard Island, supplying world DX interest.

VK3UM/3UH CW section, 7SK/7SJ phone section, 4HR/4RT open section, were the winners in the WIA's National Field Day for 1949, while NSW amateurs ran away in the trans-Tasman contest —VK2PA winner in open and phone sections, and VK2QL in the CW section.

DX AND PERSONAL

RON, VK1ADS, back from Macquarie Island, Antarctica, passed through Sydney on his way back home. He sailed from the island on a NZ frigate and arrived here via New Zealand. Ron's summing up of DX position down there was that it was "not so hot," although he worked 48 countries in his sojourn down south.

The QSL position will soon raise problems of hours of work. It is really a welcome home to a list of 3000 QSL cards outstanding—not very enticing. It is intended to print a special card depicting activity down south and they should be ready in February. The DX fraternity will undoubtedly appreciate Ron's effort and it is certain that some of the DX-minded amateurs around Melbourne will assist in the arduous task.

VK1RD and VK1AJT are still on Macquarie Island, and it is believed that the relieving operator is also an amateur. During his brief stay in Sydney, Ron was entertained by VK2JP, 2BX, 2AKR and 2QR.

CR5UR has been active again around 0800 hrs. EAST, 14,150 kc/s, the rarest piece of DX around these days. As far as is known VK2JP is the only station to collect the CR5, and that was some months ago.

ZS8A puts a nice signal through on 14,370 kc/s between 0200/0300 hrs. EAST, a bit early for most, but it is a nice country. Another phone station is VP4TJ, 14,140 kcs, 2130 hrs. Conditions seem to be improving slightly after an extremely bad period for some months.

A number of PJ's are active on CW, PJ5CE and PJ5TR, the latter the most active on 14,100 kc/s, 2000 hrs. EAST, and QSL via W4BYF. DX man VK3BZ can direct cards to PJ5CE.

Hank, KJ6AF, still promises to QSL but only when yours arrives. Hank says try another QSL to APO 105, c/o PM, San Francisco, if you have missed to date.

MIB in the small republic of San Marino on the east coast of Italy, has been heard at 1900 hrs. on 14,100 kc/s. Turkey has been represented by TA3AA, 14,020 kc/s Jules always QSL's and Jim TA3FAS, works on 14,075 kc/s, both at their best during the afternoons our time.

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F.M. RECEIVER

Continued from page 83

production tests.

When wiring the receiver, remember that it is a VHF job and long leads are completely inadmissible. One bolt of each socket should be selected as an earth-point and made common for all returns pertaining to that stage. It is preferable to run each return separately to the earth-point rather than to join them all together first. Use mica bypasses where specified.

Follow these rules and there should be no special difficulty in getting the receiver into operation.

Although the alignment procedure was given in the November, 1949, issue of Radio and Hobbies, we will repeat it in full for the benefit of those readers who might not have seen it before. It will also assist others in becoming familiar with the procedure.

Set the generator to 10.7 Mc and, by feeding the output to the mixer grid, peak all IF cores or trimmers but the last one, for maximum output. It is preferable to employ some form of output meter when doing this, so that the individual transformer responses can accurately be aligned to the centre frequency. You will need to keep the input to the mixer grid quite small to do this successfully, otherwise the limiting action of the second EF50 will tend to mask the actual peak.

CARE NEEDED

Now screw the discriminator secondary trimmer (use an all-ebonite tool to do this) until you find a sharp dip in the note from the AM signal generator. The dip indicates that the discriminator is passing through resonance and is achieving at least partial balance.

Having found this very critical point, unbalance the trimmer a trifle so that you can hear the generator signal again and repeak the primary trimmer for maximum output. Then set the secondary trimmer for minimum audible output.

Having completed this preliminary adjustment, rock the generator dial slightly to either side of resonance. You will hear the signal "peak" on either side of 10.7 Mc, but the chances are that the two peaks will be somewhat different in amplitude.

Assuming this to be so, alter the setting of the slug in the top of the discriminator transformer, and repeat the adjustment on the trimmers. Note whether the alteration of the position of the slug has improved matters or vice versa. Do the best you can by this means to balance the peaks on either side of 10.7 Mc—the centre frequency.

Variation in the value of the 0.05 megohm loading resistor may possibly assist in achieving the desired balance.

The degree of balance which can actually be achieved depends largely upon the characteristics of the discriminator, and the IF channel as a whole. Actually, the individual constructor can do very little to change these characteristics once he has settled for a certain combination of components.

Let's assume, then, that the peaks are still somewhat unbalanced after all of these measures have been taken . It is possible to improve matters by juggling the whole response curve of the IF channel against that of the discriminator transformer.

Leaving all other adjustments set, detune the secondary very slightly, and the zero output or null frequency will shift a shade to one side of 10.7 Mc. Now rock the generator dial to either side of this new frequency and note whether the balance has been improved.

By very careful adjustment of the secondary trimmer, you should be able to arrange a null point very close to 10.7 Mc, but with substantially equal output peaks on either side.

In a sense, this method may be an improvisation, but we have consistently found it to be a good backstop if the characteristics of the discriminator transformer do not permit the normal method to bring success.

Remember, however, that these adjustments are rather critical, and plenty of care is warranted if the peak of performance is to be achieved.

All this may sound involved at first reading; but, after all, it is no more complicated than the usual see-saw padder adjustment of an AM set.

If you have no oscillator or generator available, you can only hope to peak the circuits whilst listening to the FM station. Keep the input low, preferably by lowering the dipole aerial, so that effects of your adjustment are more easily noticed. Tune the discriminator secondary trimmer for maximum centre response with, as far as possible, equal and much weaker side responses.

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S.1.14

OFF THE RECORD — NEWS & REVIEWS

I have written quite a bit lately about some electrical aspects of radiograms. There are in addition many mechanical aspects which in their way, are just as important in ensuring good results. Often they don't receive as much thought as they should.

By JOHN MOYLE

PERHAPS the most irritating mechanical noise which can spoil reproduction, although it seems a fairly obvious one to cure, is caused by direct radiation from the pickup of noise and chatter.

This noise is the mechanical counterpart if I can so put it of the process of playing a record. As you know, it is the lateral movement imparted to the needle or stylus by the record grooves which causes the pickup to act as an electrical generator. But if you listen to the pickup playing with the audio control turned off, as I'm sure you must have done, you will hear the music reproduced quite clearly by this direct radiation from the pickup.

A little thought will reveal that any object which vibrates at an audio frequency must cause a disturbance in the surrounding air, and we will hear this as sound.

Most of the sound from the pickup heard in this manner is fairly high pitched, with a fatal weakness for soprano voices and heady tenors! These simply cut through the air like a knife through cheese, and can be heard quite easily all over the average room.

The bass notes are, of course, reproduced just as are any others, but the radiation efficiency of a pickup needle at these low frequencies is very poor—almost nil, in fact. Therefore, you don't hear them.

The amount of this mechanical noise varies quite a bit from one type of pickup to another. There isn't much point in analysing just why this is, but it ties up with the length and stiffness of the needle and armature, and the ability of the moving parts to radiate sound energy.

The presence or otherwise of this mechanical noise does not indicate that there is something wrong with the pickup, nor does it necessarily mean that it has anything to do with the quality of the reproduction. We can consider it chiefly as a blessed nuisance which must be removed.

It is strange that some people apparently do not realise the importance of suppressing this noise. But I have known more than one case where a pickup has been operated without a covering lid, and the owners complain bitterly that the high notes in their equipment were distorted. In many cases the unwanted noise is quite loud enough to be heard through quite respectable volume, and at low levels can easily be louder than the output from the loudspeaker itself.

LID NEEDED

The only sure way to cut out this trouble is to see that the pickup is covered by a good, soundproof lid which fits lightly where it rests on the cabinet. In many cases, this means more than a wood-to-wood contact. It may be necessary to line the edge of the cabinet with some material such as velvet which will effectively seal the edge for sound when the lid is down.

If the lid is made of very light wood—sadly enough I have seen cabinets that way—some of the sound may still filter through. Lining the lid with extra wood or thick, absorbent material may improve matters a good deal, and probably reduce the sound to a negligible amount.

There are some motors sold with the advice that ventilation slots should be cut in the motor board to prevent overheating of the motor. These are not necessary if the motor projects into an open-backed cabinet, where there is plenty of circulating air. Just a point, but it is certain that some of my readers have struck trouble with sound leakage through such slots or other holes.

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YOUR CHASSIS AND CABINET

(Continued from Page 78)

speaker baffle free from the cabinet walls on rubber pads.

Most radiogram cabinets shows signs of acoustic feedback, and the trouble unfortunately increases with the power of the equipment and its overall bass response. There's no universal remedy—it is a matter of cut-and-try.

Electrically, the pickup generally needs to be connected to the chassis by shielded leads, and these should be tacked lightly around the edge of the woodwork with insulated staples. Use the same technique with the mains lead for the motor and join it into the receiver supply with a two-way junction box or a liberal wrapping of adhesive tape.

The body of the pickup, assuming it to be metal, should be grounded to the receiver chassis either separately or by way of the shielded connecting cable. An earth bond on the motor often helps to cut the last vestige of capacitive hum.

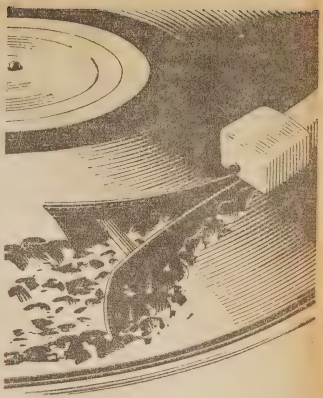
The final point . . . what to do if the cabinet perchance is slightly scratched? The best answer is to get an expert on the job, the next best is to be cautious.

SCRATCHES

Most scratches and marks are apparent because they reveal the light wood beneath the external coloring. Darken the wood and you may have to look hard to find the mark. However, beware of cheap, glossy spirit stains which tend to flow beyond the confines of the scratch and merely outline it by adding an irregular gloss around the edge.

A better scheme is to obtain a thimbleful of powdered pigment of a dull brown color, or as near as you can make it to the color of the woodwork. Work it into a paste with linseed oil, paint it into the scratch or hole with a fine brush, then wipe off the excess with a soft rag. With a little care and experiment you should be able to color the scratch and fill it somewhat at the same time. The surface on either side is not affected by the stain and can be wiped clean.

To seal the mark, you will need a spot of French polish made by dissolving shellac in methylated spirits—a slow process. With the tip of a fine brush, paint the polish over the scratch only, tilting the cabinet, if necessary, to prevent the polish from running. Allow to dry hard and then rub over well with a furniture polish.



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YET that is what you do when you use ordinary steel gramophone needles. Like jagged saw-teeth, visible only under a microscope, ordinary gramophone needles destroy the modulated groove and quickly ruin your records.

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Frazer House, 42 Bridge Street, SYDNEY, N.S.W.

PICKUP PERFORMANCE

(Continued from Page 33)

peak voltage of only a few millivolts. It is therefore generally used with a transformer which isn't much good now, as its frequency limit is reached at about 8 kc. A special 3-1 transformer with a 600 ohm output was tested, and it proved perfectly satisfactory up to 20 kc (the only pickup transformer we have seen which even approached this figure).

The idea occurred to us to fit the pickup with a high impedance coil, which would increase output and allow operation directly into the grid circuit of a valve.

After some searching, we found a suitable coil of the same dimensions as the original, and started all over again.

The improvement in output was now so great that one amplification stage (gain of 15) could be discarded, as well as the coupling transformer.

A little more pruning of the stylus eventually resulted in excellent waveform and an output of 95 milliwatts, or nearly .1 volt. This was enough to give ample volume from an amplifier of fairly representative gain, and even when fed into the standard "Williamson," plenty of volume was obtained.

This output figure given above was, of course, taken from the frequency record. The maximum level on average recordings peaks much higher than this, which makes things much better than the figure indicates.

Our pickup now has a resonance approximately the same as the best of the latest lightweights. Its output is 2½ times as great, its waveform is rather better, and its overall frequency curve is also superior.

A few remarks now on using the pickup on a high quality system, remarks which apply equally to most other high fidelity pickups.

It is important that the correct load should be placed across the pickup to keep it coil impedance within limits on the very high frequencies. Observation has satisfied us that there are certain resonances set up in the armature assembly, many of them due to scratch frequencies, which show up as fine traces on the oscilloscope, modulated round the desired waveform.

IMPORTANCE OF LOAD

Many of these unwanted frequencies, far above the audible range, appear at high amplitude, due to the greatly increased coil impedance in these regions. Wiring about 50,000 ohms across the pickup reduced them to a remarkable degree, as shown on the 'scope, at the same time bringing the value of the resonance peak down by as much as one half.

The general effect is to drop the upper portion of the curve bodily down the scale by a certain amount, so that the optimum value is one which cleans up the waveform and reduces the peak without cutting too many db from the region above about 5 kc.

For this reason, we suggest that you always follow the maker's advice in specifying the pickup load, even at the expense of some output.

The best method of cleaning the wave-form beyond this is to use a top-cut filter which comes into action just below the resonance. This will remove most of the malformation of wave-form at the lower related frequencies, and remove much of the "haziness" which may still remain due to the production of very high frequencies mentioned above. Alternatively, an absorption pad can be used to reduce the peak, but this isn't always an easy job.

Finally, although there is still much we could tell, there are some conclusions which can be drawn fairly safely from these experiments as bearing on the pickup of the future.

1. Ideally, it should have a resonance no lower than 20kc, and at least until we have records where scratch frequencies do not present an important problem, be cut at the top limit—about 16kc—to avoid harmonic distortion. Alternatively, some method should be used to suppress the resonance peak to render top-cut unnecessary. However, removal or damping of the resonance is essential.

2. End suspension of the armature seems a better scheme than centre suspension as the easiest way to push up the resonance with reasonable compliance and robust construction.

3. Discarding the head rather than the stylus seems preferred as it allows the whole assembly to be adjusted for consistent results during the life of the stylus. Replacing the armature itself, as is sometimes done, is also good, but may give rise to incorrect re-assembly in unskilled hands.

REPLACEABLE STYLII

3. Replaceable needles are not good practice, as firm attachment to the armature is virtually impossible at high frequencies. The long life of modern jewel points makes this procedure unnecessary, and in any case, preservation of correct needle-to-groove fit is so essential that no method other than the long-life, precision ground stylus can be considered.

4. Rubber damping should be avoided if possible as it is liable to age too soon, with disastrous results on suspension, compliance, and waveform.

5. Arm resonance should be avoided, as it may cause a bass rise of a shape which makes correct bass compensation difficult or impossible. Motor rumble also is accentuated by undue arm resonance, which also places great demands on the supporting bearings, necessitating careful adjustment.

6. Weight should not exceed about ½ ounce—more important in the future when we hope, micro-groove records will be produced.

7. Tracking should be well nigh perfect.

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ANSWERS TO CORRESPONDENTS

H.E.F. (Charters Towers, N. Qld.) writes in appreciation of Radio and Hobbies and suggests that some of the simpler features are ideal for beginners.

A. Thanks for the bouquet, H.E.F., and we do try to impart a wide interest to the magazine. We are not quite sure about your specific suggestions, "constant frequency circuits, noise neutralising detectors &c." The latter one sounds rathers like a technical "pipe dream."

B.B. (Pt. Pirie, SA) says he wants to become a radio engineer. He will be sitting for his Intermediate this year and asks our advice.

A. If you wish to become a fully qualified engineer, with "letters" after your name &c., there are only two obvious courses of action. One is to go on to Matriculation standard and do a University course, the other to study it at an approved Technical College. We realise that this may mean living away from home but there is really no other way out of it. You can learn quite a lot about radio through correspondence courses, of which several are available and by that means, become proficient as a serviceman or a technician in the general sense of the word. Such training, however, is seldom given the same regard as a University degree or Technical College diploma.

S.C. (Gladstone, Q.) suggests that we describe a hooded beach chair similar to those used on Sydney beaches.

We thank you for your letter and suggestion S.C. but we are afraid the article you request is, at the moment, a little beyond the scope of this magazine. That is, of course, unless a contributor comes to light with drawings and article already prepared.

R.T. (Tarragindi, Q.) tells a sorry tale of his troubles with the 4/48 Mantel Receiver. Apparently, he was unlucky enough to purchase a faulty oscillator coil but even since the oscillator coil has been replaced, the set is not exhibiting normal gain characteristics. In an effort to get more gain from the set, he has modified the bias network in such a way that there is no bias on the 6SA7-GT and the 6SK7-GT.

A. You were very unlucky with the coil oscillator coil as most manufacturers carefully check their components before allowing them to leave the factory and in the event of a fault due to poor workmanship are willing to replace them free of charge. Your approach to the problem of lack of gain is quite incorrect and will lead to short valve life. The circuit is quite in order and requires no modification.

We suggest therefore that you return the resistors omitted and look for the real cause of the trouble. Carefully check all the wiring for wrong connections, poor joints and shorts. Make sure that the valve connections are correct. If this check fails to reveal any errors, it is then a matter of using the same systematic procedure to check components. Have the valves checked or replace them with valves known to be good. Check all resistors, making sure that they are within their rated tolerance. In some cases it will be necessary to unsolder one end of a resistor so that a false reading will not be obtained due to the presence of other components in the circuit. It is rather difficult to check condensers for capacitance with an ordinary multimeter but they can easily be checked for shorts. The easiest method of checking condensers thoroughly is to try a substitute known to be good. If the foregoing fails to reveal any errors switch the set on and check the voltages while it is in operation. As a last resort, check the speaker. We regret that we cannot be more specific but there is very little more we can say to help you from the information given in your letter. The number of advertisements appearing in the Wanted to Buy, Sell or Exchange page varies from month to month and depends entirely on readers. If you are keen to obtain some "bits and pieces" to experiment with, we suggest you watch the various disposals dealers' advertisements.

No name sends in a query re small regenerative sets such as "Little Jim's Mate" for the "Answer Tom" page.

A. Thanks for your letters N.N., it will be answered as requested as early as possible. Although not necessarily for publication, it is usual to include your name and address in all queries and contributions to the "Reader Built It" and "Answer Tom" pages as evidence of good faith.

D.M.S. (Bicton, WA) write to express his interest in the "Junior Experimenter" article of crystal sets appearing in the December issue. He also lists several hints which he would like us to pass on to other crystal set enthusiasts.

A. Many thanks for your interest. We will keep your letter in mind.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes and cutouts will be supplied, if available, for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, Radio & Hobbies, Box 2728C, GPO, Sydney.

SPECIAL NOTE:—

In an admirable thirst for knowledge, some of our readers have been submitting letters which read more like a technical quiz session than legitimate queries! We do want to help you, but there is a definite limit of time which can be set aside for answers. Some conscience-stricken readers have enclosed up to 5/- with their letters, but much as we appreciate the thought, the fact is that if we spend all our time answering involved questions, we will have no time left for the magazine.

Help us, therefore, by restricting your queries to troubles you are having in your contructional work, by asking not more than two or three at a time, and by avoiding general theoretical questions which it is not the function of the Query Service to answer.

—THE EDITOR

L.J.F. (Cootamundra, NSW) asks how he could operate a 110-volt d.c. receiver from the a.c. power mains.

A.: To accomplish this directly, L.J.F., you will require a step-down transformer and a heavy duty metal rectifier. At the moment, however, the rectifier is a special item and may be very difficult to obtain. We imagine that the current rating would be beyond the capabilities of any standard valve rectifier. Other than that it would be a matter of having your set altered to operate from a.c. It is extremely difficult to provide efficient filtering for the filaments of battery valves supplied from alterating current. The problem becomes somewhat easier with low-current battery portable valves where the drain is within the capabilities of a valve rectifier, and the circuit impedance fairly high, particularly when the filaments are wired in series.

W.R.B. (of Victor Harbor, SA) says it will be a happy day for him when he sees in Radio and Hobbies an article on the construction of 32-volt receiver. He says that the voltage rise in his own particular system does not exceed more than three—up to 35 volts maximum—at a full 20 amp. charge.

A.: Your happy day has come already, as you will have seen by this, the description of our first 32-volt receiver. We trust that you will find it to your liking. Many thanks for the information about voltage rise and, to judge by the figures quoted, your batteries must be in good condition and likewise all connections. We have heard of considerably greater rise than this from other readers, one even quoting a voltage variation of from 32 to 45. Rather tough on the globes and other appliances, let alone the poor radio!

W.S.H. (Westbury, Tasmania) asks if it is possible to obtain a complete kit for the R. and H. "Karset." This set is to be operated from a 12-volt battery.

A.: Yes, W.S.H., it is possible to obtain a complete kit for this set and we suggest that you write directly to any one of our advertisers who would be only too glad to give you full information. The only alterations necessary for 12-volt operation are to ask the firm from whom you buy the kit to supply a 12-volt vibrator and vibrator transformer and then to wire the filaments in the series-parallel connection shown in the circuit diagram.

L.Y. (Newport, W15, Vic.) had a radio "which often fades out on its own accord or if it is knocked. The only thing which seems to fix it is a solid thump on the cabinet."

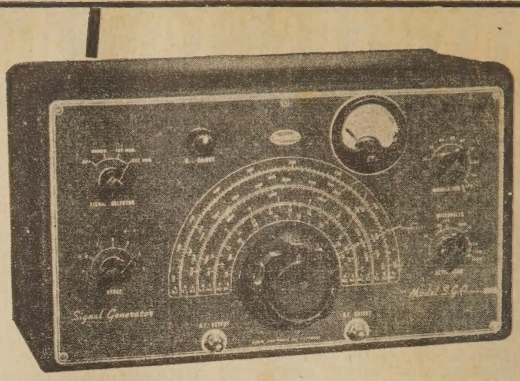
A.: We are very sorry but, with the scanty information given in your letter, there is very little we can say that will be of assistance to you. Practically any component in the set could cause the trouble you describe. Since your technical knowledge is apparently limited, the best plan may be to take the set to a reliable serviceman.

J.W. (Nyah, Vic.) wishes to operate the "All Wave Special" receiver from a battery-genemotor supply. His genemotor is only capable of supplying 60 mA. and he proposes to use battery valves in the audio stages and wonders how the omission of the back bias for the 6V6-GT will affect the rest of the receiver.

A.: Your idea is quite a good one and should effect a considerable saving in current. It is essential to provide bias of —1 and —3 volts for the tuner section and the construction of the commercial coil unit makes essential that it is back bias. However, since the secondary windings of genemotors are usually completely separate from the primary circuit, this will cause no difficulty. If you make separate provision for the bias of the audio stages, the 100 ohm resistor shown on the original circuit may be omitted. The 10 and 20 ohm resistors shown should be adjusted in inverse proportion to current drain. An article on the subject of bias, which may be of assistance to you, was published in the January issue. We note your suggestion to include more articles on radio in the magazine. However, there are many readers who are mainly interested in the popular science and workshop articles and we do our best to keep the proportion optimum.

A NEW SIGNAL GENERATOR

Model SGA



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Here is the finest Signal Generator produced by Radio Equipment. Proudly, this instrument carries the name of "University," and "University" is proud to have this instrument included in its range. It is designed to meet the needs of the Factory Production Engineer and is ideal for testing and development work. It is a perfect instrument for the trained radio service engineer. It has a wide frequency coverage, and it positively bristles with new worthwhile features.

The internal construction is such that adequate comprehensive shielding is provided. A meter is fitted which indicates the grid current of the oscillator and hence indicates the strength of oscillation. The radio frequency output is taken through a carefully constructed capacity piston attenuator to the control grid of the modulated R.F. amplifier, which is operated as a cathode follower. A Hartley type 400 cycle A.F. Oscillator with harmonic filter provides internal modulation at any desired percentage up to 100 per cent. by means of grid modulation of the R.F. amplifier. Also the 400 cycle signal is available at an A.F. output socket—its strength being adjustable by means of the modulation percentage control.

A **special feature** of this remarkable instrument is the provision for very rapid selection of commonly used frequencies by setting the tuning dial to a special mark on the scale, and selecting the **"spot" frequency** listed by means of a band selector switch. These "Spots" have been designed to occur with the tuning condenser plates almost fully in mesh so that stability is good. Special care is paid to the calibration adjustment of these points. Thus you can line a receiver easily and quickly and also check production receivers without complicated re-tuning of the signal generator. A flick of the switch selects the **"spot frequencies,"** thus cutting down work time which is valuable. This instrument goes with the times, it has a very wide frequency range covering from 110 megacycles to 155 kilocycles. The accuracy of calibration is plus or minus 1 per cent. Truly an instrument to be proud of. Here are the main specifications set out below.

FREQUENCY COVERAGE:

Band "A"—155 .... 500 K.C. Band "B"—420 .... 670 K.C.
Band "C"—550 ... 1500 K.C. Band "D"—1250 .. 3600 K.C.
Band "E"—3.5 ... 10.6 M.C. Band "F"—10 .... 30 M.C.
Band "G"—35 .... 110 M.C.

SPOT TUNING:

When the tuning dial is set to the line on the dial scale, the following commonly used frequencies can be obtained merely by setting the "Band" Selector switch to the appropriate frequency range.

Band "A"—175 K.C. Band "B"—455 K.C.
Band "C"—600 K.C. Band "D"—1400 K.C.
Band "F"—10.7 M.C.

Accuracy of spot frequencies plus or minus 0.5 per cent.

R.F. OUTPUT VOLTAGE:

Approximately 1 microvolt to 0.1 volt. Variable by capacity piston attenuator with approximately logarithmic scale, calibrated in microvolts and millivolts. Input voltage to attenuator indicated by meter showing grid current of oscillator tube.

R.F. LEAKAGE:

Less than 1 microvolt at frequencies below 3.5 megacycles.

OUTPUT IMPEDANCE:

Approximately 200 ohms.

MODULATION:

Variable amplitude modulation from zero to 100 per cent., by means of calibrated control with 30 per cent. clearly marked, is provided from internal oscillator at 400 cycles plus or minus 5 per cent. External modulation is possible at any audio frequency.

DUMMY AERIAL:

A standard I.R.E. dummy aerial, effectively shielded, is provided.

POWER SUPPLY:

190 to 260 volts A.C. at 50 cycles per second.

VALVES:

1 type 6V6GT R.F. Oscillator.
1 type 6J7G A.F. Oscillator.
1 type 6U7G R.F. Cathode Follower Amplifier.
1 type 6X5GT Rectifier.

Case Size: 14½" x 8¾" x 8¼" over controls.
FINISH: Case—Black Brocade. Panel—Dark red enamel with raised nickel-plated markings.

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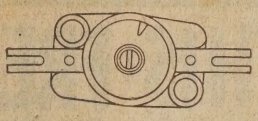

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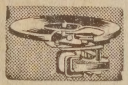

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AVAILABLE LEADING DISTRIBUTORS.

From The Serviceman Who Tells

(Continued from Page 35)

forthwith to disconnect the H.T. wiring piece by piece until I found the lead which provided the unwanted low resistance path. It proved to be a lead running to the first I.F transformer. The B-plus terminal of the transformer, which incidentally, was decoupled, measured a virtual dead short to earth. Easy, I thought, a broken down decoupling condenser.

However, disconnecting the condenser did not remove the short and it looked like a case of a faulty I.F. transformer.

Expecting to find a shorted lead, I took the can off but no, the leads were in perfect shape with no sign whatever of a short.

Most careful inspection on the low resistance ohms scale revealed that the short was actually between the palte end of the transformer and ground . . . what about the valve? It was a metal 6A8 and the moment I withdrew it from the socket the short disappeared. There was a dead short between the plate and the metal shell—presumably somewhere in the base.

Not having another metal valve on hand, I plugged in one of the new X61-M converters, checked the operating voltages and re-peaked the R.F. trimmers and the I.F. primary winding to compensate any change in capacitance. The set was really "hotted up." I also soldered one of the litz strands in the I.F. transformer which apparently had never been attached to the lug.

Oh, yes, I put in a new decoupling resistor also, the much-abused one being little more than a chunk of charcoal.

ANSWERS TO CORRESPONDENTS

B.H. (of Balgowlah, NSW) is one of many readers who is keen about the R. and H. Hobby Handbook and wants to know whether we intend to publish it monthly.

A.: Thanks for your bouquets, B.H., but we have no immediate intention of issuing the Hobby Book as a monthly publication. The idea is to produce one as the opportunity permits, in rotation with other publications like the Short Wave Handbook. Glad you liked the sports section in particular.

A.E.B. (of Katanning, WA) says he has used a 32-volt lighting plant for 28 years and, during that time, has tried all makes and types of batteries. The usual voltage rise, with charge, is to 36 volts, although as high as 40 volts has been registered with doubtful batteries. He has had good success wtih receivers operating directly from 32 volts—his "pet" circuit being one using a 79 valve in a class B output system. At present, a 250-volt genemotor is used.

A.: Thanks for your lengthy and interesting report on 32-volt systems, and receivers operating therefrom. You have apparently made quite a job of your receivers and the Class B idea sounds quite good. Many thanks for your kind remarks about our magazine.

C.R. (Sans Souci, NSW) sends in a circuit for comment in the Junior Experimenter section of R. and H.

A.: Thank you very much for the circuit, C.R.; we will deal with it as soon as possible in the pages of Radio and Hobbies.

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FOR SALE: Taylor model 120-A Multi-metre. Brand new. 1949 Edition. Snap, **£9. Ring, FX1729.**

FOR SALE: S.T.C. 9 valve communication receiver AMR300, as new. Perfect condition. 1.5 to 24 mcs. Crystal filter, B.F.O., S. meter, etc. £45. **J. MacIver, Dutton St., Hawthorne, NE1, Brisbane, Qld.**

FOR SALE: Goodmans Axiom—22. 20 watt speaker in vented enclosure designed for same. £22. **Stammel, 29 Belmore Road, Randwick.**

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FOR SALE: "Eddystone" 640 Receiver, 3 months old; also 2—6SJ7GT, —6V6GT, 6X5GT, 5V4G, 5Y3G's. Must sell—what offers? **M. K. Morris, 76 Orange Road, Parkes.**

Readers wishing to buy, sell or exchange goods are invited to insert an advertisement on this page. The cost is 1/6 per line; approximately 5 words to a line. Advertisements for the next issue must reach our office by WEDNESDAY, NOON, February 11, 1950. Dealers' Advertisements not accepted.

FOR SALE: A.T. 300 Transmitter, new condition, complete valves, motor & meters, £6. 108 Mark III chassis, new, cheap. **G. Laver, Fish Creek, Vic.**

FOR SALE: 1 Q5GT 2-valve, also 1J6G 1-valve, complete. Best offers. **W. Hughes, Cambridge St., Bulimba NE1, Brisbane, Q.**

FOR SALE: ARC Radio Engineering Course, £10. ARC construction kit and quantity of radio parts, £25. Large quantity of radio books, £5, or £35 lot. **Edgelow, 18 Edinburgh St., Box Hill, Vic.**

SALE: 3" **Oscillograph, New £20. Also 2", £10. 40 Robert St., Belmore, N.S.W. LF1257.**

SALE: Modulated Oscillator. 150Kc to 30 Meg c/s. New, £7/10/-. Also V.T.V.M. A.C./D.C., complete, £5. **40 Robert St., Belmore, N.S.W. LF1257**

SALE: Philips' DR106 Transceiver, Handbook. New. 240v. A.C., extras. Offer. **Harris, 5 Simeon St., Randwick.**

SALE:Three valve amp.- and record player, comp. less cab, £10, or offer. **WA9260.**

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SELL: F.S.6 Transceiver tuned, 40 metres, as new, also 240 volt A.C. power supply complete. Input and output meters, variable bias adj., fil. supply., £22 or will sell separately. Brand new 807 valves, 12/- each. S.T.C. battery charger, as new, £4/10/-. **Payne, 512 Pennant Hills Rd., West Pennant Hills. WM2859 after 6 p.m.**

SALE: 3 8in. Speakers, 4 pin, 10/- each. Ferrotune Chassis with straight line dial, 25/-. 385 Transformers, 10/- each. Power valves, 80, 42, 2A5, 57, 58, 45, 6C6, 8/- each. Floor model set, working, £3/10/-. Other spares cheap; write, all good. **14 Marlborough St., Smithfield, N.S.W.**

SALE: MC R1 Receiver and Power-packs. Also circuits of above, 2/- each posted. Write **K. Evans, 17 Cambridge Street, Hawthorn East, E.3, Victoria.**

SELL: Aircraft xmtrs., TA 12D and AT 10. Good. Cheap. Also 2 st. Ham rig, wkg. well. **Tel. Liv. 314. Write R. Black, George Street, Liverpool.**

SELL: 2 50 X microscopes, £1 each. **I. Mackinnon, P.B., Casterton, Vic.**

SELL: AR8 Radio Receiver, £25, or best offer. **S. Danzic, Box 35, Port Lincoln, S.A.**

SELL: Multimeter, University, AC, DC, OP, Model MVA, in new condition, complete in leatherette box. £9½ or near offer. **7 Cabban St., Mosman, Sydney. XM6005.**

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SELL: TA12D transmitter, no valves, £7/10/-. Radio altimeter, RT7/APN1, complete wtih valves, as new, £8. American Air Corps headphones in original carton, £1. **J. G. MacIver, Dutton St., Hawthorne, N.E.1., Brisbane, Qld.**

SELL: A.W.A. comm. receiver, C6770, 200kcs—30Mcs, converted for mains operation. Whit speaker and original vibrator unit. £30. **Shain, MW2484.**

SELL: Tracer University STB, £12. Tasma mantel model, with reading lamp and switch, £14. Both as new. **Phone, Sydney, BO233 ext. 396.**

SALE: Radio & Hobbies, Vol 1, No. 1, to Vol. 10, No. 8; also Vol. 2, No. 1, to Vol. 4, No. 12, and Vol. 5—Nos. 1, 3, 5, 10; Vol. 6, No. 9; Vol. 7, Nos. 5, 6, 8, 9. Best offers. **A. L. Graley, 7 Goulburn Street, Hobart, Tas.**

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SELL: Aegia K.1. D.W. Kit, unused, 35/-. Quantity of radio parts, cheap. **Chandler, 15 Bennalong St., Granville.**

SELL BARGAIN: Valves, spkr., dials, tranny's, dual wave unit, etc., £11/10/- the lot. Full parties., **R. Vincombe, 18 Elm Grove, Nth. Brighton, Vic.**

SELL: First two vols. R & H. Complete less two issues. Also nine spare copies. Offer. **J. Croft, 17 Berry St., North Sydney.**

SELL: Complete copies of Radio & Hobbies, June '45, to Dec. '49, less Oct, '45. A.R.W., Jan., May., June, July, Aug., '44. Complete copies May, '45 to Feb., '49, less April, '46, Dec., '46 & Aug., '47. Radio Science, vols. 1, 2, 3, 4, 6, £3. Modern Radio & Television, 3 vols., £3. Coyne Electrical & Radio Troubleshooting Manual, £2, Or offer lot or separate. **J. Gambell, 13 Weigand Ave., Bankstown, N.S.W.**

SELL 5Z3, 6B7, 6D6, 1J6G, 2/6 ea.; pair 2A3's 5/- ea.; F12 20.00 F.C. Rola speaker £1; 100ma 385v P.T. 15/-; 60ma 285v P.T. as new, 12/6; Fil Trans. 6.3, 5 and 2.5v 7/6; 125ma 400v P.T. no Fils 7/6; 1 3-gang T/C 7/6; 1 gang H T/C 5/-; Write **M. Clarke, 21 Charlotte Street, Toowoomba.**

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